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A NEW STAR ATLAS.

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A NEW STAR ATLAS

FOR

THE LIBRARY, THE SCHOOL, AND THE OBSERVATORY.

IN TWELVE CIRCULAR MAPS

(WITH TWO INDEX PLATES).

INTENDED AS A COMPANION TO

'WEBB'S CELESTIAL OBJECTS FOR COMMON TELESCOPES.'

WITH A LETTERPRESS INTRODUCTION ON THE STUDY OF THE STARS,

ILLUSTRATED BY SEVERAL WOODCUTS.

BY

RICHARD A. PROCTOR, B.A. (CAMB.) F.R.A.S.

AUTHOR OF

'THE SUN,' 'OTHER WORLDS THAN OURS,' 'SATURN AND ITS SYSTEM,'

'A NEW LARGE STAR ATLAS,' 'THE GNOMONIC STAR ATLAS,'

'THE HANDBOOK OF THE STARS,' ETC. ETC.

'Why did not somebody teach me the Constellations, and make me at home in the starry heavens, which are always overhead, and which I don't half know to this day?' CARLYLE.

LONDON:

LONGMANS, GREEN, AND CO.

1872.

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PREFACE.

THIS ATLAS is reduced from my large Star Atlas. The plan on which it has been constructed—briefly described in the accompanying letterpress—needs no special discussion here; because I have already fully dealt with it in the introduction to the large Atlas. I may remark, however, that the present work affords new and striking evidence of the advantages of the plan; for we have here a little book which can be carried in the pocket, while the small Atlas published by the Society for Diffusing Useful Knowledge is printed on sheets about sixteen inches square; and yet the scale of the accompanying maps is larger than that of the S.D.U.K. Atlas. The reduction in size is gained chiefly by a reduction in the distortion of the maps, the maximum expansion due to this cause being *fifty-eight* times greater in the S.D.U.K. maps than in the present (see note at pp. 11, 12). Moreover, the twelve maps of this Atlas overlap, a fifth part of the heavens being included in the overlaps; so that each of the twelve maps exhibits a tenth part of the heavens.

No pains have been spared to clear the maps of all which could cause confusion to the beginner; but this has been done in such a way that the more advanced student may find nothing wanting. For example, the meridians and parallels are drawn in to every fifteenth, instead of every fifth degree (as usual); but, since all the intersections of these lines to every fifth degree are marked in the maps (with a small cross), the places of stars can be determined, from catalogues or the like, as readily as though the lines themselves were marked in. In like manner all the longitude and latitude lines, except the ecliptic and the solstitial colures, are omitted; but their intersections to every fifteenth degree are marked (with a small dotted cross), and any student who is sufficiently advanced to require these lines will be able to recognise very readily where they lie, or to pencil them in if need be. I consider their omission, and the omission of all but every third of the meridians and parallels usually introduced, to be absolutely essential for the convenience of the majority of those who will use these maps; though the maps would, undoubtedly, be imperfect if the position of these lines were not indicated.

The method of indicating the effects of precession is also novel. Instead of a precession-triangle in the corner of each map, with instructions for obtaining compass measurements, I have placed precession-arrows over the maps (always on latitude-parallels, 15°, 30°, &c.); and these show at once by what amount

stars in the neighbourhood are precessionally displaced in one hundred years. In passing, however, let me call the student's attention to the fact (often forgotten) that the stars suffer no real displacement, and that he will do well to regard the effects of precession as shifting the meridians and parallels bodily in a direction contrary to that indicated by the arrows.

The constellation boundaries are somewhat darker than I would have had them if I had not had to consider the requirements of beginners. It seems to me very necessary that the extent of each constellation should be recognisable at a glance (at least by most of those who will use these maps). Indeed, if no other means would suffice for this, the spaces should be coloured as in geographical maps. I think the present arrangement meets all requirements.

As to the constellation-figures, I conceive that few will be disposed to regret their omission from the present Atlas. The old usage—by which a star's place was indicated by a reference to the club of Orion, or the northern claw of the Crab, or the southern wing of the Virgin, and so on—is happily falling into disuse; and, as the number or letter of a star is always mentioned, even by those who employ the ancient practice, no difficulty can ever arise in finding any star referred to.*

* In my Gnomonic Atlas the figures are shown. The plates belonging to that atlas form the index plates of my large atlas, and can also be obtained separately.

It is of more importance to notice that the present Atlas is specially intended to serve as a companion to Mr. Webb's excellent treatise, 'Celestial Objects for Common Telescopes.' With a very few exceptions, all the objects mentioned in that work are shown in this Atlas. The exceptions relate to objects (some twenty in all, perhaps) which could not be introduced without overcrowding. To make up for these omissions, however, several hundreds of objects not included in Mr. Webb's charming work are shown in this Atlas. Thus, all the objects in Admiral Smyth's 'Celestial Cycle,' all the binary stars in Mr. Brothers's catalogue, all the Red Stars in Schjellerup's catalogue,* all the nebulæ down to the order marked 'very bright' in Sir J. Herschel's great catalogue, are introduced here, with only such exceptions (perhaps a score in all) as were necessary to avoid overcrowding. It is hoped that, with this unusual richness in objects of interest, the Atlas will prove a complete *vade mecum* for the amateur telescopist.

I have to thank Mr. Webb for the careful revision of the Atlas, so far as the objects to be included in

* Some of these stars would appear to be variable in colour; at least Mr. Webb and other careful observers do not recognise any ruddiness in certain stars included in Schjellerup's catalogue. Such stars are marked 'Ru?' The student should notice, also, that the catalogue is incomplete, many red stars having been noted since it was drawn up. Furthermore, many of the stars included in the catalogue are not properly speaking *red*, but may rather be described as orange or ruddy yellow.

his treatise are concerned. In the course of this revision he has noticed several discrepancies between the constellation outlines in this work (based on the British Association Catalogue) and those used in Smyth's 'Bedford Cycle.' As Mr. Webb's 'Celestial Objects' is closely associated with the 'Cycle,' he has not thought it desirable to remodel the arrangement of the constellations; and, on the other hand, as this Atlas is a miniature of my 'New Star Atlas,' I should have been unwilling to change the constellation outlines, even if I did not entertain the opinion that Baily's changes result in an immense improvement. The student will therefore be prepared to find that some few objects described in 'Celestial Objects' as in one constellation are here shown in another; and even that some constellations mentioned in 'Celestial Objects' (as Antinous, Anser, Clypeus, &c.) are here omitted altogether. But no difficulty need arise on this account, because Mr. Webb in every case mentions the right ascension and declination of the several objects.

The letterpress introduction has been prepared for the use of beginners, who often find it difficult to compare the heavens with the maps of a star-atlas. I would recommend, as a convenient supplement to the information contained in these pages, my work entitled the 'Half-Hours with the Stars,' published by (and the property of) my friend Mr. Hardwicke, of Piccadilly. Its twelve maps show how the stars are placed, night by night and hour by hour, throughout

the year in England. Thus they serve a purpose wholly distinct from that of such a star-atlas as the present. Each work is, however, complete in itself; and, as the 'Half-Hours with the Stars' suffices to teach the merest beginner the names and places of all the leading star-groups, so the present will enable the learner to identify all the stars of the first five orders of magnitude; that is, all the stars except the faintest of those seen on very dark and clear nights.

RICHARD A. PROCTOR.

BRIGHTON: *December* 1871.

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HOW TO LEARN THE STARS.

On a clear, but dark night, we see many hundreds of stars of various orders of brightness. Those who are but beginning the study of the heavens are impressed with the feeling that it must be a very difficult task to become familiar with all the star-groups, and to learn the names of the brighter orbs. The task appears yet harder when they are told that the stars seen on one night or at one hour are not the same as those seen on other nights or at other hours—that the aspect of the starry heavens is in fact continually changing. Yet nearly all wish to know the stars, even though they may not wish to engage in the actual study of astronomy. In reality, it is by no means so difficult as might be supposed to recognise all the chief star-groups—or *constellations*, as they are called—and to learn the names of all the leading stars. One may, without much trouble, become so well acquainted with the stars as to be able to recognise even three or four seen through a break in a cloudy sky. I propose now to show how such knowledge is to be gained.

In the first place, the student must learn what is the true arrangement of the stars as distinguished from that which he sees at any instant from some standpoint on the earth. He views the heavens as a dome, or hollow half-globe, on the inside of which the stars are spread in hundreds. But he must remember that beneath the horizon there is another similar half-globe, passing right round under his feet, and similarly bespread with stars. *If the earth were perfectly transparent, and the light of the sun were lost, the observer on*

earth would find himself placed seemingly at the centre of a vast hollow globe covered with stars. And if he could continue to watch this globe hour after hour, day after day, and year after year, he would find that all the stars* kept their places on the globe, but that the globe itself seemed to turn bodily round, as if on an axle passing through his own position. There would be a ceaseless and perfectly uniform turning round of the sphere of stars, but in other respects there would be no perceptible change in the position of any of the stars.

The earth not being transparent, we see at night but one half of this rotating sphere; and the light of the sun being sufficient to obliterate that of the stars, we cannot in the daytime see the sphere of stars at all. But the learner must remember that one and the same star-sphere surrounds him on all sides, below as well as above the horizon, and at all hours, by day as well as by night. It is because the stars do not change in their position *on this sphere* that they are called *fixed stars*. Their fixity enables us to recognise the groups which they seem to form. A well-marked group of stars, once recognised, cannot easily be forgotten; and it becomes thenceforth a sort of skymark whence the learner can proceed to other groups. And as there are certain star-groups which always continue above the horizon, the observer who has learned to recognise some of them, can on any clear night extend his survey from these known groups to others that are unknown.

It is easy to see why some groups are never carried below the horizon, notwithstanding the continual rotation of the star-sphere. Two points of the turning sphere are necessarily fixed. These are called the *poles* of the celestial sphere. In England one of these poles—the north pole of the heavens—lies due north, and rather more than halfway above the horizon, towards the point overhead (called the *zenith*). The other point is, of course, below the horizon, due south, and rather more than halfway down towards the point directly under the observer (called the *nadir*). If the observer faces

* The light of the sun being obliterated, neither the moon nor any of the planets would be visible.

due south, the stars near the horizon on his left hand, or towards the east, have lately risen, and are passing higher; those near the horizon on his right hand, or towards the west, are about to pass below the western horizon. Those which rise above the horizon nearly due east, will pass higher and higher till they are due south, when they will be rather less than half-way from the southern horizon towards the point overhead. Thence they will descend until they are nearly due west, when they will pass below the horizon. If the observer, having duly recognised the nature of this motion (which corresponds exactly with the seeming motion of the sun on a spring or autumn day), remembers that it is brought about by the rotation of the whole sphere of the stars, he will at once see what must be the nature of the stellar motions in other parts of the heavens. He will see that stars which rise on any part of the horizon from east to south will follow a similar course, but shorter and shorter the nearer their place of rising is to the south point; their elevation when due south will also be less and less; and they will follow a descending course precisely resembling their ascending course, setting just as far to the west of the south point as they rose to the east of it. A star which is on the horizon when due south can only be seen for a minute or two, just grazing the southern horizon. Stars which rise in any part of the horizon from east to north, will also continue to pass higher and higher till they are due south, following a longer and longer course, the nearer their place of rising is to the north point; their elevation when due south will also be greater and greater; and they will follow a descending course precisely similar to their ascending course, setting just as far to the west of the north point as they rose to the east of it. A star which is on the horizon when due north performs a complete circuit before it again reaches the horizon, when it is due north as before; its highest point being reached when due south after half a circuit, at which time it is but about thirteen degrees from the point overhead. No stars *within* the circuit of such a star ever reach the horizon at all. Each performs a complete circuit, which is smaller and smaller

the nearer the star is to the pole of the heavens. A star which, when due north, is about 13 degrees above the horizon, is almost exactly overhead when half a circuit has been completed. Stars nearer to the pole than this are due north when at their highest in their circuit as well as when at their lowest.

But let the student be reminded that all these varieties of motion are the effects of but one single turning movement. He must not suffer himself to be confused by these motions as described (I have, however, described them as clearly as I could); but if he finds doubt arising in his mind, when he is actually studying the stars, let him face due north, and, *looking towards the north pole of the heavens (a point rather more than halfway above the northern horizon towards the point overhead)*, let him remember that *the stellar sphere moves as though turning bodily round on an axis,—running from that pole through his own station (which is at the centre of the sphere) to a point directly opposite the former,—the rotation being such that stars near the pole move round it in a direction contrary to that in which the hands of a watch move.* It will serve equally well *if he faces due south*, and remembers that *the stellar sphere is being carried round from left to right, as though on an axis passing through his station and the invisible pole (which lies below the southern horizon, and rather more than halfway down towards the point directly beneath him)*.

The rate at which the stellar sphere rotates must next be considered.

Roughly speaking, the sphere of stars may be said to turn round once in each day; but in reality it turns rather more quickly, so as to make one complete rotation in about four minutes less than a day. Thus a star which rises in the east takes six hours (less about one minute) to reach the highest part of its path, when it is due south; and it takes the same interval in passing to its setting-place in the west. It is, therefore, twelve hours above the horizon. Stars whose place of rising lies nearer the south are less than twelve hours above the horizon. Stars which rise to the north of the east point are more than twelve hours above the horizon. Stars which touch

or pass above the northern horizon take twenty-four hours (less about four minutes) in circling round the pole of the heavens.

It is well to remember that the resulting motion of the stars can be easily recognised in a very few minutes. This may be shown in a variety of ways. If a star is seen above or beside some distant object, as a tree or house, then if the student remain in an unchanged position for a few minutes only, he will see that the star has perceptibly changed its place. If the star is towards the east, it seems to have moved upwards and towards the right. If it is towards the west, it seems to have moved towards the right, and downwards. If it is towards either the south or the north, it seems to have moved horizontally towards the right. (All stars near the horizon move towards the right, though only those towards the north and south move horizontally.)* Ten minutes will produce an unmistakable change of place.*

* It is strange how little familiar most persons are with the fact that the stellar motions are thus obvious. The notion seems to prevail that only the astronomer in his protracted night-watching can become cognizant of the stellar motions. One of the most beautiful and touching descriptions in all Dickens's works—the death of Stephen Blackpool, in *Hard Times*—is somewhat impaired by the introduction of an impossible star, shining for hours down the deep chasm into which the poor fellow had fallen. The mouth of the Old Hell Shaft was so narrow a chasm as to be concealed by tall grass. Stephen fell far down; and the star was so bright that he could show it to Rachael among all the other stars visible on an autumn night. Certainly no such star exists in the catalogues of astronomers. It is probable, however, that Dickens may have heard some such story about a bright star—Venus or Jupiter—only the star cannot have been seen just overhead. Novelists and poets sometimes introduce astronomical details rather unhappily. One has made the new moon rise at one o'clock in the morning; another makes midnight moonless though the moon had risen at eleven; in the 'Portent' (a tale which appeared in one of the early numbers of the *Cornhill*) a star is made to shine midway between the horns of the crescent moon! But, perhaps, all the slips of the sort ever made are outvied by one in the opening line of Chapter XII. Book IV. of *Our Mutual Friend*. Tennyson is singularly accurate in all astronomical details. In *Maud* such details are somewhat freely introduced; but so correctly that Mr. Hind himself could take no exception to any of the astronomical statements.

So much for the motions of the stars on any given night. But there is also an apparent motion of the star-sphere from day to day. I have mentioned that the star-sphere turns once completely round on its axis in the course of rather less than twenty-four hours. Thus in twenty-four hours it has gone rather more than once round. *Hence, if we look at the heavens night after night at the same time, we notice precisely the same kind of change as when we look at the heavens hour after hour on the same night.* Suppose that we look at the stars at ten o'clock on any night and note their position, and that again we note the position of the stars at eleven o'clock on the same night; then, if afterwards we examine the stars night after night at ten o'clock, we shall find that at the end of about fifteen days they have at this hour the same position that they had on the first night at eleven o'clock—that is, they have advanced by one hour's motion. In a month or thereabouts, they will be found to have advanced by two hours' motion. In a year they advance by twenty-four hours' motion, that is, by one complete rotation, so that they have resumed their original positions. In fact, *in the course of a year the star-sphere turns round once oftener than there are days in the year.**

If the learner, recalling the nature of the rotation to which the star-sphere is subject, remembers also that (roughly) the star-sphere turns round once in a day, he will know what changes to expect as any night progresses, and if he further remembers that (roughly) the star-sphere makes one extra turn in the year, he will know what changes to expect as the year progresses.

Now, to aid the student in learning the names and features

* The amount by which the stars have advanced each night on the position they held at the same hour on the preceding night is by no means so small as is, perhaps, commonly imagined. This is easily tested. Let there be an upright of any sort a few yards to the north of the observer's station, and let him notice the exact hour when a star (at a fair height above the horizon) appears from behind the edge of this upright. At this hour on the next night he will find that, as seen from the same station, the star is about two moon's breadths past the upright's edge. The observer should look through a fixed tube placed in the same position on each night.

of the star-groups, maps may be devised on one of two plans. Either we may have maps showing the aspect of the heavens at different hours and at different seasons; *or*, we may have maps constructed with sole reference to the star-sphere itself. Maps of the former kind form perhaps the simplest possible introduction to a knowledge of the heavens. If they are properly constructed, the learner can at once turn to the map representing the heavens at any hour and season of any year (such maps serve for all years), and then he can at his leisure compare the stars he sees with those pictured in the map. In my work, entitled *Half-Hours with the Stars*, the maps not only serve these purposes, but they show at once towards what point of the horizon and at what height each star is situated. Maps of the second class are, however, absolutely necessary to supplement the information given by the others. All considerations are sacrificed to simplicity in the construction of maps of the former kind; no meridians or parallels can be shown; none but the brighter stars can appear; only those parts of the star-sphere can be included which actually rise above the horizon; and a variety of details, which even the beginner soon begins to require,* must necessarily be omitted. Maps of the latter kind form an atlas of the stellar globe, and can be made to include any details which may be desired.

The present work is an atlas of this sort. It pictures in twelve maps the stellar sphere which surrounds our earth; and it is as suitable for use in one country as in others—at our

* It must not be supposed, however, that such maps are useful only for beginners. It is most convenient, even for the advanced student of astronomy, to have a book from which he can at once determine what stars are above the horizon, and in what positions, at any hour of any night. I believe, also, that such a work as my *Constellation-Seasons* (now out of print), in which the equator, ecliptic, colures, &c., were depicted, is calculated to serve very useful purposes. If the lithographs of those charts had been better drawn than they actually were (owing to the difficulties met with in transfer work), I should not have suffered the work to be out of print, especially as the sale of the first and only edition was very encouraging. If I should at any time republish the work, I should redraw the maps for photolithographic reproduction.

antipodes as here in England, in the Western as in the Eastern Hemisphere.

But a globe may be pictured in maps in many different ways; some useful for one purpose, some for others. It is necessary to describe the plan on which the present atlas has been formed, before considering its use in helping the student of the heavens.

Any flat pictures of portions of a globe must necessarily be somewhat distorted. The larger the portion, the greater will be the distortion. Yet we must not divide the celestial globe into too many parts to form a celestial atlas; because if we do, the student will be puzzled to know how these parts fit in, so to speak, to form the globe. There is a similar objection to the irregular division of the celestial globe. Some *regular* plan of dividing the globe into a *moderate number of portions* must be employed.

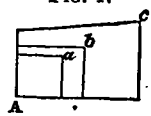
Only two such plans (out of five which are possible) need be here considered. According to one, the globe is divided into six equal portions; according to the other, into twelve.

The first is easily understood. Imagine a case shaped like a die or cube—that is, with six square sides—the sides being made of some elastic material; and conceive that by blowing air into this case the six elastic sides are made to bulge out in such sort that the case becomes globe-shaped. Then the six sides, which had been square and flat, are changed into curved surfaces, all four-pointed and all alike in shape and size. If we suppose the star-sphere divided into six such portions, and an atlas constructed to show these portions in six separate maps, such an atlas would correspond to the first plan.

The fault of this mode of dividing the star-sphere is that the six parts are too large to be well shown on a flat surface. The distortion, especially for parts near the corners of the six portions, must be considerable. The plan has been employed in Mr. Keith Johnstone's atlas, and in the atlas published by the Society for Diffusing Useful Knowledge; but the distortion is so great in these atlases that a small space on the star-sphere occupies an area more than five times greater if it falls near an angle of the map than if it falls near the centre. The

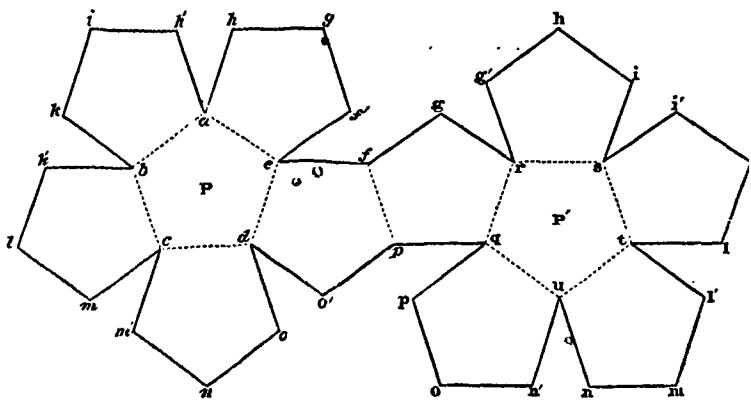
shape of a star-group is also so modified as to render the recognition of the group very difficult. For example, the stars within a small square space, such as A *a*, fig. 1, are thrown into a space of the shape and size of A *c*, if they chance to fall near the angles of a map.*

Fig. 1.



The other plan (employed in the present atlas) is also readily described. Suppose a piece of card to be cut into the form represented in fig. 2, and half through along the dotted lines. Then, if the five pentagons round *a b c d e* be bent up till *f* coincides with *f'*, *h* with *h'*, and so on, and the like with the

Fig. 2.



pentagons round q r s t u, and if these sets of six pentagons be bent up (from the line *f g*) till *g* coincides with *g* and *g'*, h with *h* and *h'*, and so on, a closed figure will be formed. It is represented in two positions in figs. 3 and 4, the dotted lines being supposed to be seen through the figure. Now, imagine the

* The shape of the distorted figure will only be as A *c* when the square space has a certain position with respect to the corner. In other cases A *a* may be thrown into a diamond-shaped figure as large as A *c*; or into intermediate shapes,—always as large, however, as A *c*. This variety causes the effects of the distortion to be yet more perplexing than they would otherwise be.

twelve faces of this figure to be made of some elastic material, and that as in the former case air is blown in until the figure becomes globe-shaped. Then the twelve faces, which had been five-cornered and flat, are changed into curved surfaces, all five-pointed and all alike in shape and size. In the present atlas the star-sphere is supposed to be divided into twelve such portions, one of which is represented in each of the twelve maps following the two index-maps. The five angles of these five-cornered spaces are shown by the five marks on the circular border of each map, but each map includes more than the five-pointed space—in fact each map includes the space within a circle carried (on the sphere) round the five-pointed space

FIG. 3.

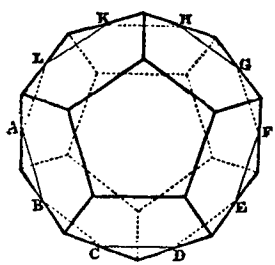
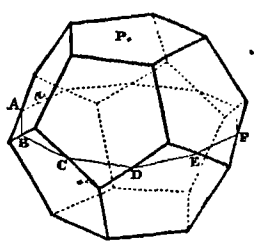


FIG. 4.



proper to the map. Thus there results a symmetrical overlapping of the maps, each map overlapping and being overlapped by five other maps. But for this many star-groups would be inconveniently broken up (as in other star-atlases) where the map-edges fell; as it is, groups that would be thus broken are shown in two maps.

This mode of dividing the star-sphere having been adopted, the next point to be considered was the choice of a mode of presenting the several divisions. I need not enter here into a consideration of the various methods available for mapping any given portion of the heavens.* It will be suffi-

* They are described, and their principal properties compared, in my *Handbook of the Stars*. The properties of the gnomonic projection as

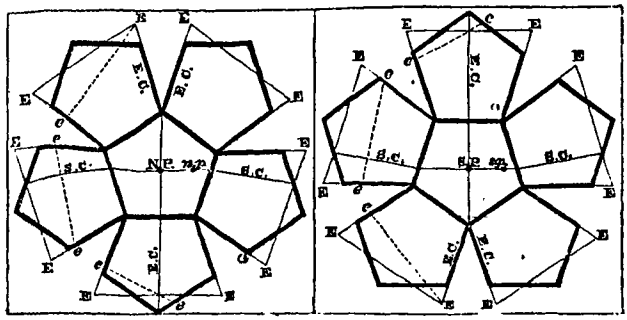
cient to note that the plan employed in the present work reduces the distortion to its least possible amount. If the same method of mapping were employed as in the two celestial atlases above referred to, the present plan for dividing the sphere would still reduce the distortion so greatly that a sphere as A *a* (fig. 1) would be expanded (near the angles of a map) only to the size and shape A *b*,* instead of A *c*. But the method of mapping actually employed so reduces the distortion that a space as A *a*, fig. 5, is expanded (near the border of a map) only to the size and shape A *a'*—a distortion which is not only the least possible in maps including so large a portion of the heavens, but is scarcely discernible save by practiced eyes.†

FIG. 5.

applied to the mode of dividing the sphere employed in this atlas, are discussed in the letter-press introduction to my *Gnomonic Star-Atlas*.

* In my *Gnomonic Atlas* this method of construction is actually employed, and the twelve maps are included in two sheets by the method of arrangement indicated in fig. 6. It will be noticed that all the maps

FIG. 6.



have straight edges (this being a peculiarity which results from the law of projection). The comparison of fig. 6 with the two index-plates in the present work, will serve to illustrate the arrangement of the twelve portions into which the star-sphere is divided.

† The following facts serve to illustrate the advantages possessed by the present atlas in these respects over the atlases referred to in the

But it still remains to decide how the twelve divisions of the star-sphere shall be portioned out. It is easily seen, however, that since every five-pointed face has a face directly opposite to it (see fig. 4), two such opposite faces should be assigned to the northern and southern polar regions, the poles of the star-sphere being placed at the centres of these two maps. The remaining ten maps, five northern and five southern, interlap, as shown in fig. 4, their ten common angles lying alternately north and south, of a medial circle between the two poles (the celestial equator as it is called), represented in fig. 4 by the regular ten-sided figure A B C D E F. . . . .*

text. A small area whose surface would be represented by 14 if it fell at the centre of one of the S. D. U. K. maps, is so distorted if it fall near the angles as to have an area of 72, an increase of 58; such an area in the present atlas is increased only from 14 to 15 when it falls near the edge of the map, an increase of only 1, that is one fifty-eighth part of that in the S. D. U. K. maps. Again, owing to distortion, each map of the S. D. U. K. series covers a surface almost exactly twice as great as that of the corresponding part of the sphere. The maps of the present series cover severally a surface exceeding only by about one twenty-eighth part the actual surface of the corresponding portions of the sphere.

* There still remains some choice as to the adjustment of northern and southern polar maps, and with them the remaining ten maps, but practically the choice rests between two positions. There is a certain circle through the poles called the equatorial colure (see the index-plates), from one half of which all measurements around the celestial equator are taken, as from a starting-place. It is necessary for purposes of symmetry that this half of the equinoctial colure should either pass through an angle of the north polar map, or through the middle of a side. According to the present arrangement it passes through the middle of a side; the only reason why this plan was preferred being that the boundaries of the maps came thus to be better situated with respect to the most important star-groups. It happens very fortunately that by the present arrangement all the most important star-groups are preserved unbroken, in some map or other of the series. (The seven chief stars of the Greater Bear are separated in Maps 6 and 8, but are seen together in Map 1.) I received letters from Sir John Herschel and Professor De Morgan on this subject. The latter, referring to my *Gnomonic Atlas*, pointed out the advisability of trying to save Orion from being divided. It will be noticed that Orion is thus saved in the present series by means of the overlaps. Sir

Thus there are two polar maps, and ten equatorial maps, five of which are northern and five southern. It is obviously convenient to call the north polar map No. 1; to take the ten equatorial maps in order round the equator, beginning with that northern map which is divided through the centre by the equinoctical colure, and taking the rest alternately north and south; and thus, lastly, there remains the south polar map, which is therefore No. 12.

This arrangement is further illustrated by the two index-maps, each of which contains six complete circular maps and parts of other five. The first index-map shows the whole of the northern half of the star-sphere, as well as a zone belonging to the southern half; the second index-map shows the whole of the southern half and a zone belonging to the northern half. It will be understood that although the double circles (which in reality represent the circular 'frames' of the twelve larger maps) are not equal in size on the planisphere, this arises only from the inevitable distortion where so large a portion of the sphere is shown.*

A careful comparison of the portions numbered from 1 to 12 in the index-plates with the corresponding maps in the atlas

John Herschel went over the maps *seriatim*, coming to the conclusion that the boundary lines could not have fallen more happily.

* In reality, even those five wide double arcs which form a large curved pentagon within the boundary of each index-map, belong on the sphere to circles no larger than those enclosing the small central circular maps 1 and 12 of the index-plates. I may notice in passing the evidence afforded by the index-map of the mistake which has been made by those who have asserted that in the stereographic projection similar portions of the sphere are similarly figured. Thus, the space enclosed between circles 1 and 2 in the first index-plate is obviously very different in shape from the space enclosed between the circles 2 and 3, yet on the sphere these spaces are identical in size and shape. Again, the space between circles 3 and 11, and a declination-parallel just touching these circles (I refer to the inner circle of the map-frames), is very different in shape from the space between the circles 2 and 4, and the circle enclosing the whole series of maps in the index-plate. Yet on the sphere these utterly dissimilar sections are identical in all respects.

series, will serve to explain the construction of the atlas better than any verbal account. The student should, in a special manner, note the overlapping spaces in the index-plates and compare them with the corresponding spaces in the atlas maps. He will thus learn to recognise the value of those overlaps, and the means they supply for passing readily from one map to another. He will notice, further, that the numbers round the atlas maps (close by the circular frame) show what map to turn to, when the student wishes to pass, in any direction, beyond the limits of the map he is engaged with.

In comparing the heavens with the maps of this atlas, it is to be noticed that the whole of the space included in Map 1 is at all times visible. This is the polar map; and if on a clear night the student turn towards the north and raise his eyes to a point somewhat more than halfway from the horizon towards the point overhead, he will recognise, in the stars there seen, the group which lies at the centre of Map 1.

It is customary to find the pole-star (marked Polaris) by means of the seven stars of the Great Bear (Ursa), shown at the top of Map 1. These stars cannot be mistaken, and the two marked α and β serve as pointers to the pole, lying as they do very nearly on a line with Polaris. Fig. 7 shows where the seven stars are to be looked for at four seasons of the year, at the hours named beside the figure. It will be understood that fig. 6 presents one half of the celestial vault—the northern half. On examining different parts of the figure, the part marked 'overhead' is always to be regarded as the top, the semicircular boundary (corresponding to the horizon) being the bottom. For instance, in seeking to determine where the seven stars are at midnight on December 21 (or at ten on January 21), turn round fig. 7 until the group of seven stars, marked II., is under the point marked 'overhead' (so that the word north-east is horizontal). Then the seven stars are seen, the *three* forming the Bear's tail (or the horses of the Waggon, or the handle of the Plough), being lowermost. From the position of the seven stars the student learns that if he looks due north-east, and towards a point exactly halfway between

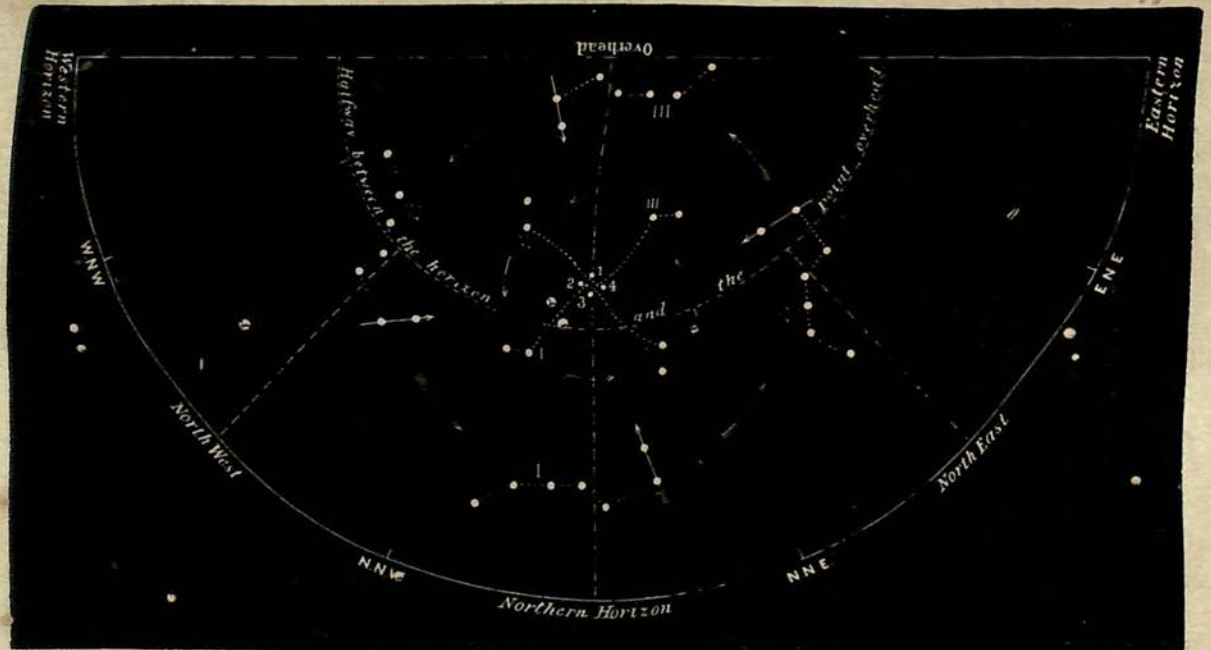


FIG. 7, showing the elevation and bearing of the Pointers, Pole-star, &c., at the following seasons and hours :—

At Midnight	11 P.M.	10 P.M.	9 P.M.	Great Bear is at	Little Bear is at	Pole-star is at
On September 21	October 6	October 22	November 6	I.	I.	1
,, December 21	January 5	January 21	February 5	II.	II.	2
,, March 23	April 8	April 23	May 8	III.	III.	3
,, June 22	July 7	July 22	August 7	IV.	IV.	4

the horizon and the point overhead, his view will be directed towards the middle of the group of four stars forming the Waggon or the body of the Plough. He can therefore readily find the seven bright stars, and the two which lie uppermost (almost on a horizontal line) are the Pointers. They show him the pole-star on their left,—and at the moment nearly on the same level, at the place marked 2,—the three bright stars of the Little Bear lying in the position marked II. And so with the cases corresponding to other seasons. Also it is very easy for him to see where the seven stars will be at intermediate hours or seasons. The large arrows indicate the direction in which the seven stars are carried by the daily rotation of the star-sphere. The course of the pair of stars (called 'the Guardians of the Pole') belonging to the Little Bear is also shown by arrows; and arrows are placed on the Pointers in the four several positions indicated in the figure.

Now the learner, being able at all seasons of the year to find these leading stars of Map 1, can not only always study any of the constellations belonging to that map, but can at any time pass from that map to any of the other maps (2, 3, 4—to 11) the stars belonging to which are at that time suitably placed for observation. He can at once see from Map 1 itself which of the other maps can be most conveniently used. For instance, supposing the date to be March 25, and the hour midnight, he will find that the Great Bear is as at III., fig. 7, nearly overhead; and to compare Map 1 with the heavens, he holds it with Ursa uppermost, and finds Cassiopeia low down towards the north, the stars of Draco towards the north-east high up, and so forth. Now if he wishes to examine the stars lying beyond the Great Bear, or on the southern side of the point overhead, Map 1 at once tells him which maps to employ. For he finds on the edge, close by the 's even stars' of Ursa, the words Map 8 on one side and Map 6 on the other; so that either of these maps will serve his purpose. He turns to Map 8 and finds in it, near the top (where the words Map 1 are written), the three tail-stars, and can so proceed to find the stars of Boötes, Serpens, and so on. Or he turns to Map 6,

and finds again at the top the Pointers and another of the four body stars, and can thence proceed to find the stars of Leo, Gemini, and so forth.

But it is convenient for him to know, in an independent manner, what maps of the series 2, 3, 4—11, can be most usefully studied at any season of the year. It is also well for him to know in what position he may expect to find the spaces corresponding to the different maps.

For this purpose figs. 8 and 9 have been provided. I here represent severally the whole celestial vault,* the centre of each being the point overhead, and the circumference being the horizon; and they show how the spaces corresponding to the several maps of the series are arranged when either 2, 4, 6, 8, or 10 has its centre due south, or else 3, 5, 7, 9, or 11. In fig. 8 Map 2 is shown with its centre due south, in fig. 9 Map 3; and it will be observed that the rotation of the heavens carries the space corresponding to Map 2, from the position shown in fig. 8 to the position shown in fig. 9, in the tenth part of a day, or in 2 h. 24 m.

The following tables serve to show at what hours and seasons the centres of the several maps occupy such positions as are indicated in figs. 8 and 9.

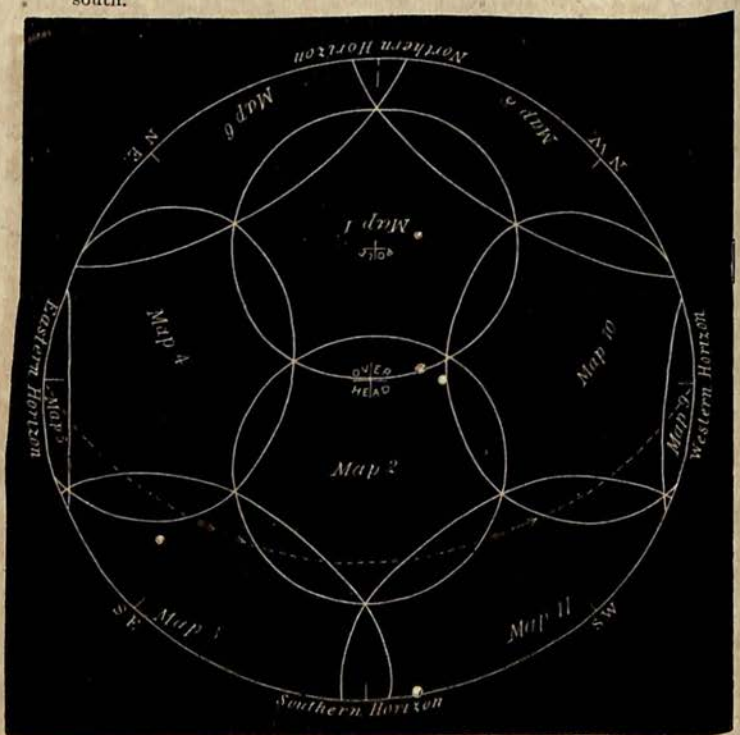
The interpretation of these tables is exceedingly simple, as is also the method of employing them. Thus the first table

* These figures have both been carefully drawn, so that the actual position of each map, not only with respect to the compass points, but also as regards elevation above the horizon, is exactly indicated. For example, in fig. 8, the common intersection of Maps 2, 3, and 4 is seen to lie almost exactly towards the south point, marked S.E., and almost exactly four-ninths of the way from that point towards the centre of the map. The corresponding point on the heavens (close by ξ Arietis) lies as nearly due S.E., and as nearly 36° above the horizon at midnight on Sept. 21. And so of all other points of intersection as well as of all points round the circumference of the different maps. The construction of both the figures involved some interesting—but not altogether simple—geometrical problems. It may be added that the equations to the curves formed in the projection by the really circular boundaries of the maps are rather singular in form.

shows us that at 10 P.M, on March 16, the celestial space corresponding to Map 8 lies towards the east (in the position occupied by Map 4 in fig. 8); the space corresponding to

FIG. 8.

Showing the arrangement of the spaces included in the maps of this atlas, when the centre of one of the Maps 2, 4, 6, 8 or 10 is due south.



The actual arrangement is such that Fig. 8 corresponds to the aspect of the heavens at midnight

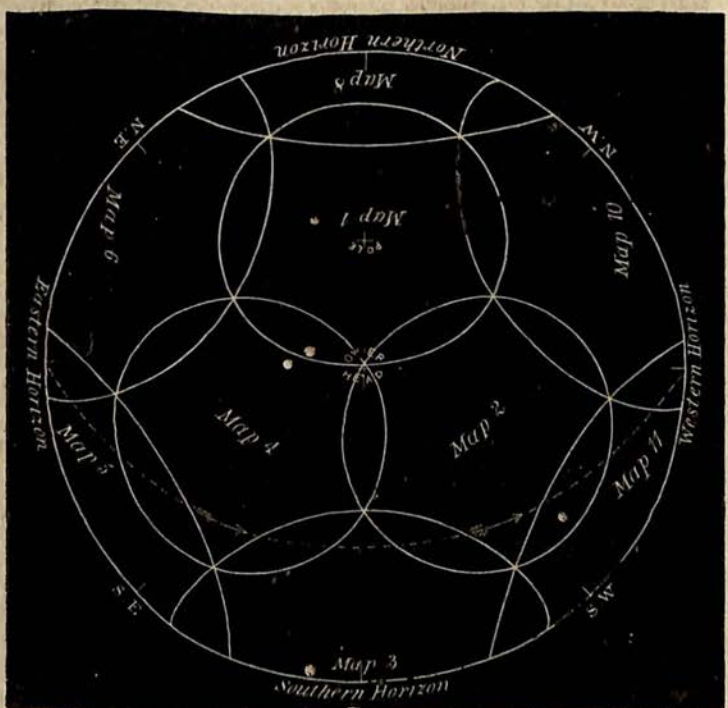
(The student should make five tracings of each map, num-

Map 6 is due south (in the position occupied by Map 2 in fig. 8); and so on. Again, suppose we require to know when the space corresponding to Map 7 will be well placed for ob-

servation. On comparing figs. 8 and 9, we find that the space corresponding to Map 7 must always be low down, but will be best placed for observation when due south, as Map 3 in

FIG. 9.

Showing the arrangement of the spaces included in the maps of this atlas, when the centre of one of the Maps 3, 5, 7, 9 or 11 is due south.



Sept. 21 ; Fig. 9 to their aspect either 2h. 24m. later (on the same night), or at midnight Oct. 27.

bering the several spaces in each from Tables I. and II.)

fig. 9. Turning to Table II., we find that the space 7 is due south at midnight on March 22, or at 11 on April 7, or on the dates named in the third date-column at the corresponding

TABLE I.

6 P.M.	Dec. 21	March 5	May 17	July 28	Oct. 10
7 P.M.	Dec. 5	Feb. 17	May 1	July 12	Sept. 24
8 P.M.	Nov. 22	Feb. 2	April 16	June 27	Sept. 9
9 P.M.	Nov. 6	Jan. 17	April 1	June 12	Aug. 24
10 P.M.	Oct. 22	Jan. 2	March 16	May 28	Aug. 9
11 P.M.	Oct. 6	Dec. 17	March 1	May 13	July 24
Midnight	Sept. 21	Dec. 2	Feb. 14	April 28	July 9
North (high)	Map 1	Map 1	Map 1	Map 1	Map 1
East	" 4	" 6	" 8	" 10	" 2
South (high)	" 2	" 4	" 6	" 8	" 10
West	" 10	" 2	" 4	" 6	" 8
Low down (As in Fig. 8) N.-East	" 6	" 8	" 10	" 2	" 4
Low down (As in Fig. 8) S.-East	" 3	" 5	" 7	" 9	" 11
Low down (As in Fig. 8) S.-West	" 11	" 3	" 5	" 7	" 9
Low down (As in Fig. 8) N.-West	" 8	" 10	" 2	" 4	" 6
1 A.M.	Sept. 6	Nov. 18	Jan. 30	April 13	June 24
2 A.M.	Aug. 21	Nov. 3	Jan. 14	March 29	June 9
3 A.M.	Aug. 6	Oct. 19	Dec. 30	March 13	May 25
4 A.M.	July 21	Oct. 3	Dec. 14	Feb. 26	May 10
5 A.M.	July 6	Sept. 18	Nov. 29	Feb. 11	April 25
6 A.M.	June 22	Sept. 3	Nov. 13	Jan. 24	April 10

TABLE II.

6 P.M.	Jan. 25	April 11	June 22	Sept. 3	Nov. 14
7 P.M.	Jan. 10	March 27	June 7	Aug. 18	Oct. 30
8 P.M.	Dec. 26	March 11	May 23	Aug. 3	Oct. 15
9 P.M.	Dec. 10	Feb. 23	May 7	July 18	Sept. 30
10 P.M.	Nov. 27	Feb. 8	April 22	July 3	Sept. 15
11 P.M.	Nov. 11	Jan. 23	April 7	June 18	Aug. 30
Midnight	Oct. 27	Jan. 8	March 22	June 3	Aug. 15
High North	Map 1	Map 1	Map 1	Map 1	Map 1
High S.-East	" 4	" 6	" 8	" 10	" 2
High S.-West	" 2	" 4	" 6	" 8	" 10
Low down (As in Fig. 9) North	" 8	" 10	" 2	" 4	" 6
Low down (As in Fig. 9) N.-E. (Easterly)	" 6	" 8	" 10	" 2	" 4
Low down (As in Fig. 9) S.-E. (Easterly)	" 5	" 7	" 9	" 11	" 3
Low down (As in Fig. 9) South	" 3	" 5	" 7	" 9	" 11
Low down (As in Fig. 9) S.-W. (Westerly)	" 11	" 3	" 5	" 7	" 9
Low down (As in Fig. 9) N.-W. (Westerly)	" 10	" 2	" 4	" 6	" 8
1 A.M.	Oct. 11	Dec. 23	March 7	May 19	July 30
2 A.M.	Sept. 26	Dec. 8	Feb. 20	May 4	July 15
3 A.M.	Sept. 11	Nov. 24	Feb. 5	April 19	June 30
4 A.M.	Aug. 26	Nov. 9	Jan. 20	April 4	June 15
5 A.M.	Aug. 11	Oct. 25	Jan. 5	March 19	May 31
6 A.M.	July 26	Oct. 9	Dec. 20	March 4	May 16

hours shown in the hour-column. Part of the celestial space shown in Map 3 never rises in our latitudes.

The student will notice that the part corresponding to the top of the Maps 2, 3—11, lies towards the pole, and that the celestial space corresponding to a map is only placed vertically, so to speak, when due south or due north. But there is nothing in this that need inconvenience him, if he will notice only that the several maps can always be turned round so as to agree with the actual position of the included star-groups. For instance, supposing the observer is examining the part of the heavens shown in Map 4 at midnight on September 21, when this region is situated as shown in fig. 8; then, if he holds the map as printed, he will not find the star-groups on the heavens in the same position as in the map. But fig. 8 shows him that the angle where Map 4 overlaps Maps 1 and 2 is uppermost at the moment; and he has but to hold the map so that this angle (in the upper right-hand corner) is highest, to have the constellations of this map in their proper position. He then has Orion leaning backwards, as in the heavens at the time, Taurus over Orion's head, Perseus over Taurus, the Twins almost horizontal on Orion's left; and so on. But if the hour is midnight on January 8, he finds from Table II. that the space corresponding to Map 4 is in the south-west, high up; and turning to fig. 9, he finds that this space has the position marked as Map 2. The angle where Map 4 overlaps Map 1 and Map 6 (now placed as Map 4 in fig. 9) is almost exactly overhead. Holding the map with this angle (in the upper left-hand corner) highest, he has the constellations in their proper relative positions—Orion leaning forwards, and the Twins over Orion's head, and Taurus facing Orion on his right.

And with equal simplicity the suitable position for any map at any hour may be ascertained.

The following table will be found convenient also for some purposes. It has been formed from my 'Constellation Seasons' *

* The dates are, however, altered. In preparing the *Constellation Seasons* I paid careful attention to the sun's varying motion in longitude,

TABLE III.—*Constellations visible in the Latitude of London throughout the Year.*

	Horizon.	
Dec. 21, Midnight Jan. 21, 10 P.M. Feb. 21, 8 P.M.	N.	Draco, Ursa Minor.
	E.	Leo, Lynx.
	N.E.	Boötes, Ursa Major.
	S.E.	Hydra, Gemini.
Jan. 21, Midnight. Feb. 21, 10 P.M. March 23, 8 P.M.	N.	Cygnus, Draco, Ursa Minor.
	E.	Virgo, Coma,* Ursa Major.
	N.E.	Corona, Ursa Major.
	S.E.	Crater, Leo.
Feb. 21, Midnight. March 23, 10 P.M. April 23, 8 P.M.	N.	Cepheus, Ursa Minor.
	E.	Serpens, Boötes.
	N.E.	Hercules, Draco.
	S.E.	Virgo, Leo.
March 23, Midnight. April 23, 10 P.M. May 24, 8 P.M.	N.	Cassiopeia, Cepheus, Ursa Minor.
	E.	Ophiuchus, Hercules, Corona.
	N.E.	Cygnus, Draco.
	S.E.	Libra, Boötes.
April 23, Midnight May 23, 10 P.M. June 22, 8 P.M.	N.	Cassiopeia. Ursa Minor.
	E.	Aquila, Lyra, Hercules.
	N.E.	Cygnus, Draco.
	S.E.	Ophiuchus, Serpens.
May 23, Midnight June 22, 10 P.M. July 22, 8 P.M.	N.	Perseus, Ursa Minor, Draco.
	E.	Pegasus (ε), Cygnus, Lyra.
	N.E.	eda, Cepheus.
	S.E.	Sagittarius, Aquila, Hercules.

	Overhead.	Horizon.
Auriga.*	Orion, Canis Major.	S.
	Perseus, Pisces.	W.
	Taurus, Eridanus.	S.W.
	Cassiopeia, Cygnus.	N.W.
Lynx.	Gemini, Canis Minor.	S.
	Auriga, Taurus, Aries.	W.
	Orion, Eridanus.	S.W.
	Cassiopeia, Andromeda.	N.W.
Ursa Major.	Leo Minor, Leo, Hydra.	S.
	Lynx, Auriga, Taurus.	W.
	Cancer, Canis Minor, Canis.	S.W.
	Camelus, Perseus.	N.W.
Ursa Major.	Coma, Virgo, Corvus, Hydra.	S.
	Lynx, Gemini.	W.
	Leo, Hydra.	S.W.
	Auriga, Perseus.	N.W.
Ursa Major (η).	Boötes, Virgo, Centaurus.	S.
	Ursa Major, Leo Minor, Cancer.	W.
	Canes Ven., Coma, Crater.	S.W.
	Ursa Major, Lynx, Auriga.	N.W.
Hercules.	Corona, Serpens, Scorpio.	S.
	Canes Ven., Leo.	W.
	Boötes, Virgo.	S.W.
	Ursa Major, Lynx, Gemini.	N.W.

	Horizon.		Overhead.		Horizon
June 22, Midnight. July 22, 10 P.M. Aug. 21, 8 P.M.	N.	Auriga, Camelus, Ursa Minor.	Draco.	Hercules, Serpens, Sagittarius.	S.
	E.	Pegasus, Cygnus.		Boötes, Coma, Virgo.	W.
	N.E.	Andromeda, Cassiopeia, Cepheus.		Hercules, Serpens, Libra.	S.W.
	S.E.	Capricornus, Aquila, Lyra.		Ursa Major, Leo Minor.	N.W.
July 22, Midnight. Aug. 21, 10 P.M. Sept. 21, 8 P.M.	N.	Lynx, Ursa Minor, Draco.	Cygnus.	Cygnus, Aquila, Capricornus.	S.
	E.	Pisces, Andromeda (α).		Hercules, Corona, Boötes.	W.
	N.E.	Perseus, Cassiopeia, Cepheus.		Lyra, Ophiuchus.	S.W.
	S.E.	Aquarius, Pegasus.		Draco, Ursa Major.	N.W.
Aug. 21, Midnight. Sept. 21, 10 P.M. Oct. 22, 8 P.M.	N.	Ursa Major, Ursa Minor, Cepheus.	Lacerta.	Pegasus, Aquarius, Piscis Aust.	S.
	E.	Taurus, Aries, Andromeda.		Cygnus, Lyra, Hercules.	W.
	N.E.	Auriga, Camelus, Cassiopeia.		Cygnus, Aquila, Sagittarius.	S.W.
	S.E.	Cygnus, Pisces.		Draco, Boötes.	N.W.
Sept. 21, Midnight. Oct. 22, 10 P.M. Nov. 22, 8 P.M.	N.	Ursa Major, Ursa Minor, Cepheus.	Cassiopeia.	Andromeda, Pisces, Cetus.	S.
	E.	Orion, Taurus, Perseus.		Cygnus, Aquila.	W.
	N.E.	Lynx, Camelus.		Pegasus, Aquarius, Capricornus.	S.W.
	S.E.	Cetus, Aries, Andromeda.		Cepheus, Draco (β), Hercules.	N.W.
Oct. 22, Midnight. Nov. 22, 10 P.M. Dec. 21, 8 P.M.	N.	Ursa Major (η), Draco, Ursa Minor.	Perseus.	Triangula, Aries, Cetus.	S.
	E.	Canis Minor, Gemini, Auriga.		Lacerta, Delphinus, Aquila.	W.
	N.E.	Leo Minor, Camelus.		Andromeda, Pegasus (β), Aquarius.	S.W.
	S.E.	Lepus, Orion, Taurus.		Cassiopeia, Cepheus, Lyra.	N.W.
Nov. 22, Midnight. Dec. 21, 10 P.M. Jan. 21, 8 P.M.	N.	Hercules, Draco, Ursa Minor.	Perseus.	Taurus, Eridanus.	S.
	E.	Leo, Cancer, Gemini, Auriga.		Andromeda, Pegasus.	W.
	N.E.	Ursa Major, Camelus.		Aries, Cetus.	S.W.
	S.E.	Canis Major, Orion, Taurus.		Cassiopeia, Cepheus, Cygnus.	N.W.

* The constellation whose name is placed thus is that in which the point overhead is situated at the hour named.

(published in 1866); but for the idea of this particular application of that work I am indebted to Mr. Lockyer's 'Elementary Lessons in Astronomy.'

The following list of constellation-names* in Latin and English, will be found useful. Only those constellations are admitted into the list which are recognised in the catalogue of the British Association:—

TABLE IV.

Andromeda, *The Chained Lady* (Map 2).
Antlia, *The Air-Pump* (Map 7).
Apus, *The Bird of Paradise* (Map 12).
Aquarius, *The Water-Bearer* (Map 11).
Aquila, *The Eagle* (Map 10).
Ara, *The Altar* (Map 9).
Argo, *The Ship Argo* (Map 6): subdivided into—
(i) Carina, *The Keel.*
(ii) Malus, *The Mast.*
(iii) Puppis, *The Poop.*
(iv) Vela, *The Sails.*
Aries, *The Ram* (Map 4).
Auriga, *The Waggoner* (Map 4).
Boötes, *The Herdsman* (Map 8).
Cælum, *The Sculptor's Tools* (Map 3).
Camelus, *The Camel* (for Cameleopardalis) (Map 1).
Cancer, *The Crab* (Map 6).
Canes Venatici, *The Hunting Dogs* (Map 8).
Canis, *The Dog* (for Canis Major) (Map 5).
Canis Minor, *The Lesser Dog* (Map 5).
Capricornus, *The Sea-Goat* (Map 11).
Cassiopeia, *The Lady in the Chair* (Map 1).
Centaurus, *The Centaur* (Map 7).
Cepheus, *The Monarch* (Map 1).
Cetus, *The Sea-Monster* (Map 3).
Chamæleon, *The Chameleon* (Map 12).
Circinus, *The Compass* (Map 12).

&c., forgetting, in my anxiety to secure accuracy, that, as a matter of fact, the year must simply be portioned out into intervals as nearly equal as possible. Those who possess my *Constellation Seasons* would do well to pencil the above dates in place of those mentioned at the foot of the several plates. Lockyer's 'Lessons' should be similarly corrected.

* In the present atlas I have not thought it advisable to introduce all the new names which I have used in my large atlas; but some of the changes I retain, because they cannot in any way perplex the learner, and are much more convenient than those in use. Thus the constellation Vulpecula et Anser is here called Vulpes, Corona Borealis is called Corona, Cameleopardalis is called Camelus; and so on.

Columba, *Noah's Dove* (Map 5).
Coma Berenices, *Berenice's Hair* (Map 8).
Corolla, *The Wreath* (for Corona Australis) (Map 9).
Corona, *The Northern Crown* (for Corona Borealis) (Map 8).
Corvus, *The Crow* (Map 7).
Crater, *The Cup* (Map 7).
Crux, *The Cross* (Map 12).
Cygnus, *The Swan* (Map 10).
Delphinus, *The Dolphin* (Map 10).
Dorado, *The Sword-Fish* (Map 12).
Draco, *The Dragon* (Map 1).
Equuleus, *The Little Horse* (Map 11).
Eridanus, *The River Eridanus* (Map 3).
Fornax, *The Furnace* (Map 3).
Gemini, *The Twins* (Map 6).
Grus, *The Crane* (Map 11).
Hercules, *Hercules* (Map 10).
Horologium, *The Clock* (Map 3).
Hydra, *The Sea-Serpent* (Map 7).
Hydrus, *The Water-Snake* (Map 12).
Indus, *The Indian* (Map 11).
Lacerta, *The Lizard* (Map 2).
Leo, *The Lion* (Map 6).
Leo Minor, *The Lesser Lion* (Map 6).
Lepus, *The Hare* (Map 5).
Libra, *The Balance* (Map 9).
Lupus, *The Wolf* (Map 9).
Lynx, *The Lynx* (Map 6).
Lyra, *The Lyre* (Map 10).
Mensa, *The Table Mountain* (Map 12).
Microscopium, *The Microscope* (Map 11).
Monoceros, *The Unicorn* (Map 5).
Musca, *The Bee* (Map 12).
Norma, *The Rule* (Map 9).
Octans, *The Octant* (Map 12).
Ophiuchus, *The Serpent-Bearer* (Map 9).
Orion, *The Giant Hunter* (Map 4).
Pavo, *The Peacock* (Map 12).
Pegasus, *The Winged Horse* (Map 2).
Perseus, *The Rescuer* (Map 4).
Phœnix, *The Phœnix* (Map 3).
Pictor, *The Painter's Easel* (Map 5).
Pisces, *The Fishes* (Map 2).
Piscis, *The Southern Fish* (for Piscis Australis) (Map 11).
Reticulum, *The Net* (Map 12)
Sagitta, *The Arrow* (Map 10).
Sagittarius, *The Archer* (Map 9).
Scorpio, *The Scorpion* (Map 9).
Sculptor, *The Sculptor's Workshop* (Map 11).
Serpens, *The Serpent* (Map 9).
Sextans, *The Sextant* (Map 6).
Taurus, *The Bull* (Map 4).
Telescopium, *The Telescope* (Map 9).
Toucan, *The Toucan* (Map 12).
Triangula, *The (Northern) Triangles* (Map 2).
Triangulum, *The (Southern) Triangle* (Map 12).
Ursa, *The Bear* (for Ursa Major) (Map 1).
Ursa Minor, *The Lesser Bear* (Map 1).
Virgo, *The Virgin* (Map 7).
Volans, *The Flying-Fish* (Map 12).
Vulpecula, *The Fox* (Map 10).

To this table of constellation names the following table of star-names may be added :—

TABLE V.—*Star-Names.*

α Andromedæ, *Alpheratz.*
β ——, *Mirach, Mizar.*
γ ——, *Almach.*
β Aquarii, *Sadalsund.*
α ——, *Sadalmelik.*
δ ——, *Skat.*
γ Aquilæ, *Tarazed.*
α ——, *Altair.*
β ——, *Alshain.*
α Argûs, *Canopus.*
γ Arietis, *Mesartim.*
β ——, *Sheratan.*
α ——, *Hamal.*
α Aurigæ, *Capella.*
β ——, *Menkalinan.*
η Boötis, *Muphrid.*
α ——, *Arcturus.*
ε ——, *Izar, Mizar, Mirach, Pulcherrima.**
β ——, *Nekkar.*
α Canum Ven., *Cor Caroli.*
β Canis, *Mirzam.*
α ——, *Sirius.*
ε ——, *Adara.*
β Canis Minoris, *Gomeisa.*
α ——, *Procyon.*
α^2 Capricorni, *Secunda Giedi.*
δ ——, *Deneb Algiedi.*
β Cassiopeiæ, *Caph.*
α ——, *Schedar.*
α Cephei, *Alderamin.*
β Cephei, *Alphirk.*
γ ——, *Errai.*
β Ceti, *Diphda.*
ζ Ceti, *Baten Kaitos.*
ο ——, *Mira.*
α ——, *Menkar.*
α Columbæ, *Phact.*
α Coronæ, *Alphecca.*
α Corvi, *Alchiba.*
δ ——, *Algores.*
α Crateris, *Alkes.*
β Cygni, *Albireo.*
α ——, *Arided, Deneb Adige.*
π^1 ——, *Azelfafage.*
α Delphini, *Svalocin.*
α Draconis, *Thuban.*
β ——, *Alwaid.*
γ ——, *Etanin.*
α Eridani, *Achernar.*
γ^1 ——, *Zaurac.*
β ——, *Cursa.*
γ Geminorum, *Alhena.*
ε ——, *Mebsuta.*
δ ——, *Wasat.*
α^2 ——, *Castor.*
β ——, *Pollux.*
κ Herculis, *Marsic.*
β ——, *Korneforos.*
α ——, *Ras Algethi.*
α Hydræ, *Alphard, Cor Hydræ.*
α Leonis, *Regulus, Cor Leonis.*
γ^1 Leonis, *Algeiba.*
δ ——, *Zosma.*
β ——, *Deneb Alcet, Denebola, Deneb.*
α Leporis, *Arneb.*
α Libræ, *Zuben el Genubi.*

* A name given by modern astronomers to express the extreme beauty of this double star (orange and green) viewed with a good telescope.

β Libræ, *Zuben el Chamali.*
γ ———, *Zuben Hakrabi.*
α Lyræ, *Vega.*
β ———, *Sheliak.*
γ ———, *Sulaphat.*
α Ophiuchi, *Ras Alhague.*
β ———, *Cebalrai.*
β Orionis, *Rigel.*
γ ———, *Bellatrix.*
δ ———, *Mintaka.*
ε ———, *Alnilam.*
α ———, *Betelgeux.*
ε Pegasi, *Enif.*
ζ ———, *Homan.*
β ———, *Scheat.*
α ———, *Markab.*
γ ———, *Algenib.*
β Persei, *Algol.*
α ———, *Mirfak.*
α Piscis, *Fomalhaut.*
α Piscium, *Kaitain.*
ε Sagittarii, *Kaus Australis.*
α Scorpionis, *Antares, Cor Scorpionis.*
α Serpentis, *Unukalhai.*
η Tauri, *Alcyone* (Pleiad).
α ———, *Aldeboran.*
β ———, *Nath.*
ι Ursæ, *Talitha.*
α ———, *Dubhe.*
β ———, *Merak.*
γ ———, *Phecda.*
ε ———, *Alioth.*
ζ ———, *Mizar.*
80 ———, *Alcor.*
η ———, *Alkaid, Benetnasch.*
α Ursæ Minoris, *Polaris.*
β ———, *Kochab.*
β Virginis, *Zavijava.*
ε ———, *Vindemiatrix.*
α ———, *Spica Azimech, Spica.*

*** I did not think it desirable to have the names of any but the brightest stars placed in the maps themselves, which would have been much cumbered even though only stars down to the second magnitude had been named. The above list gives at least as many names as the student need care to cumber his memory with. I could wish, for my own part, that all save those names which appear in the atlas itself could be finally dismissed from star-atlases and catalogues.

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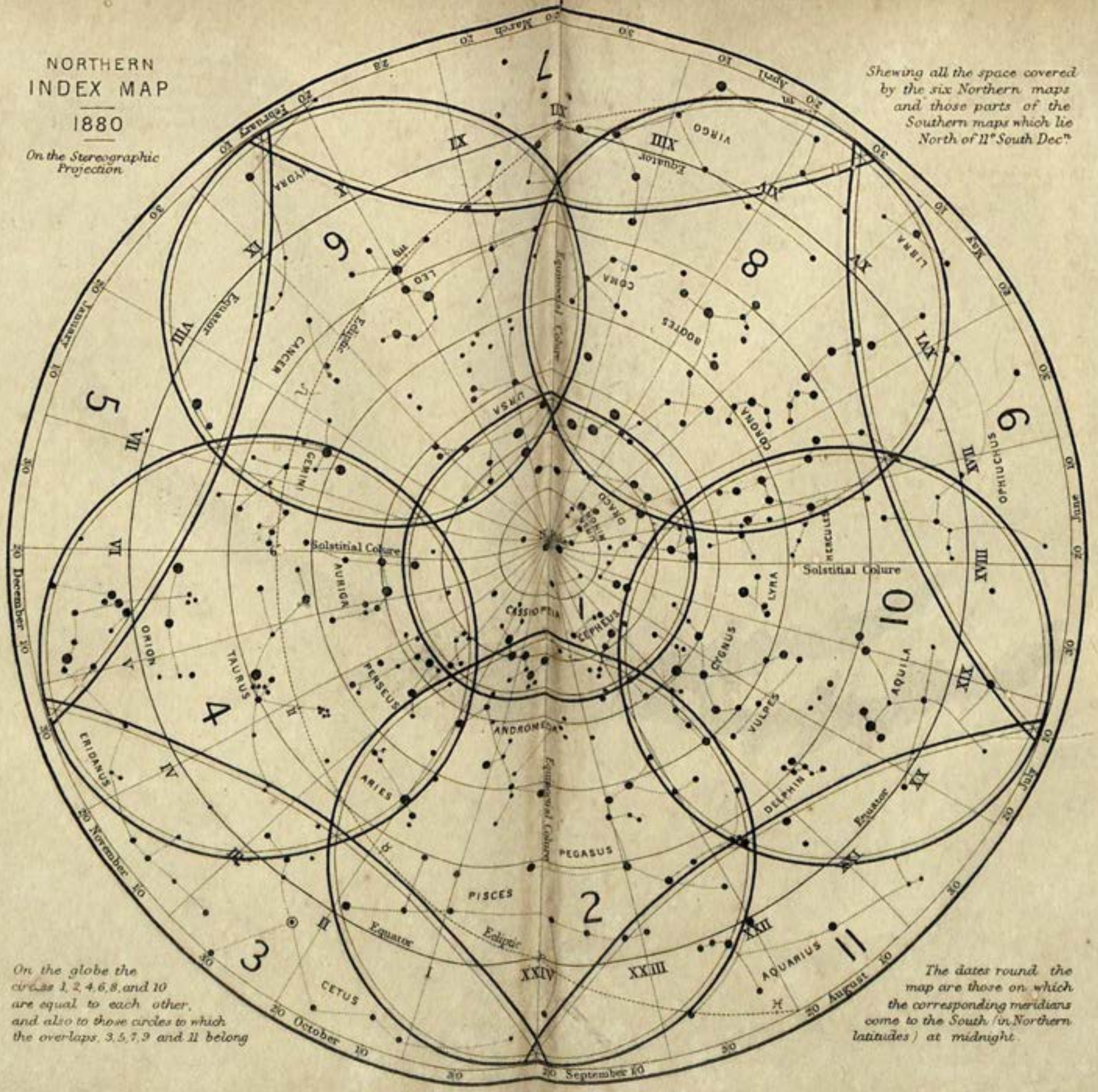
NORTHERN INDEX MAP

1880

On the Stereographic Projection

Shewing all the space covered by the six Northern maps and those parts of the Southern maps which lie North of 11° South Dec^n



On the globe the circles 1, 2, 4, 6, 8, and 10 are equal to each other, and also to those circles to which the over-laps, 3, 5, 7, 9 and 11 belong

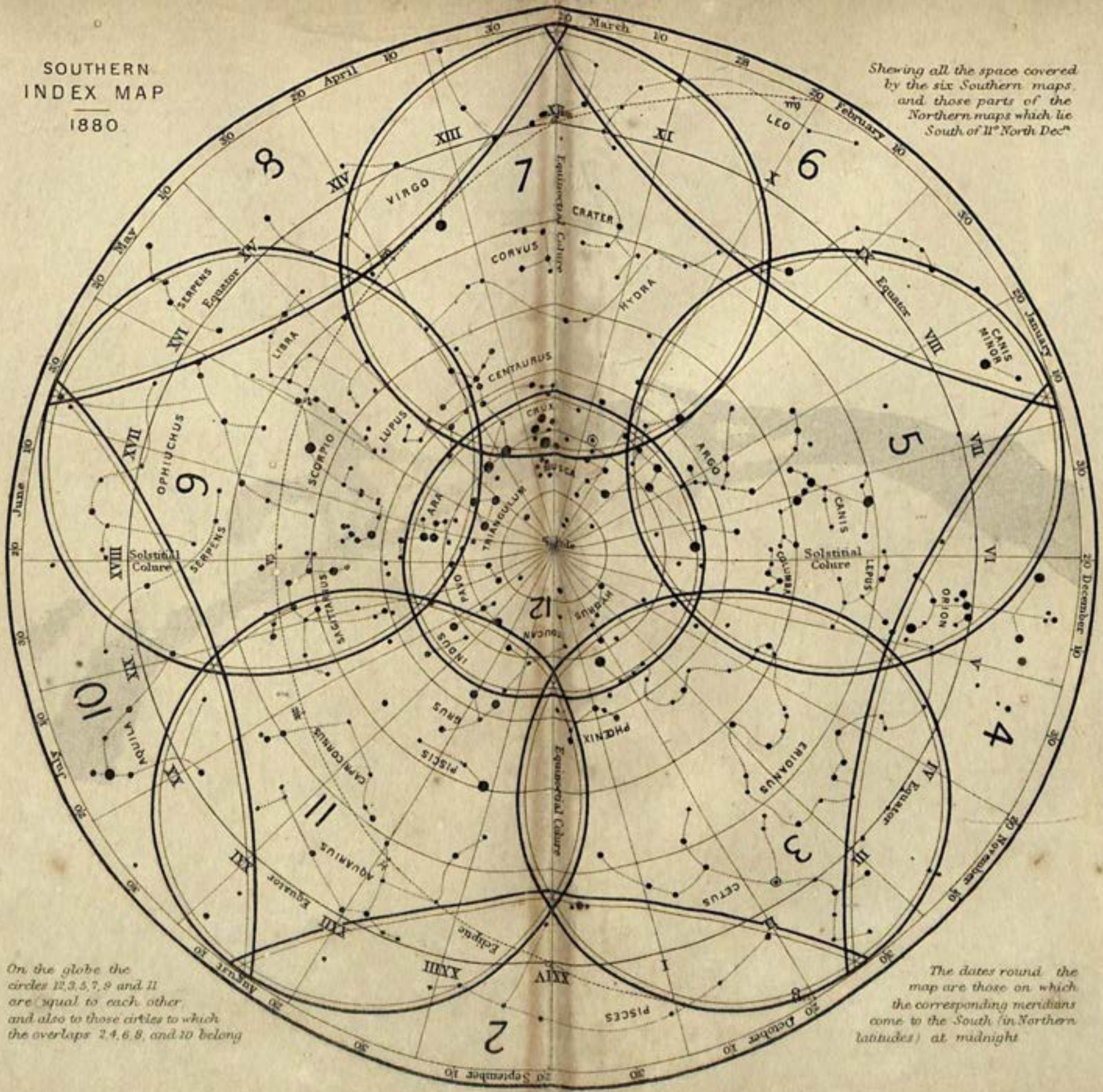
The dates round the map are those on which the corresponding meridians come to the South (in Northern latitudes) at midnight.

R. A. Proctor, Del^t — *London, Longmans & Co* — *E. Weller, Litho.*

SOUTHERN INDEX MAP

1880

Shewing all the space covered by the six Southern maps, and those parts of the Northern maps which lie South of 11° North Dec^n



On the globe the circles 1,2,3,5,7,9 and 11 are equal to each other and also to those circles to which the overlaps 2,4,6,8, and 10 belong

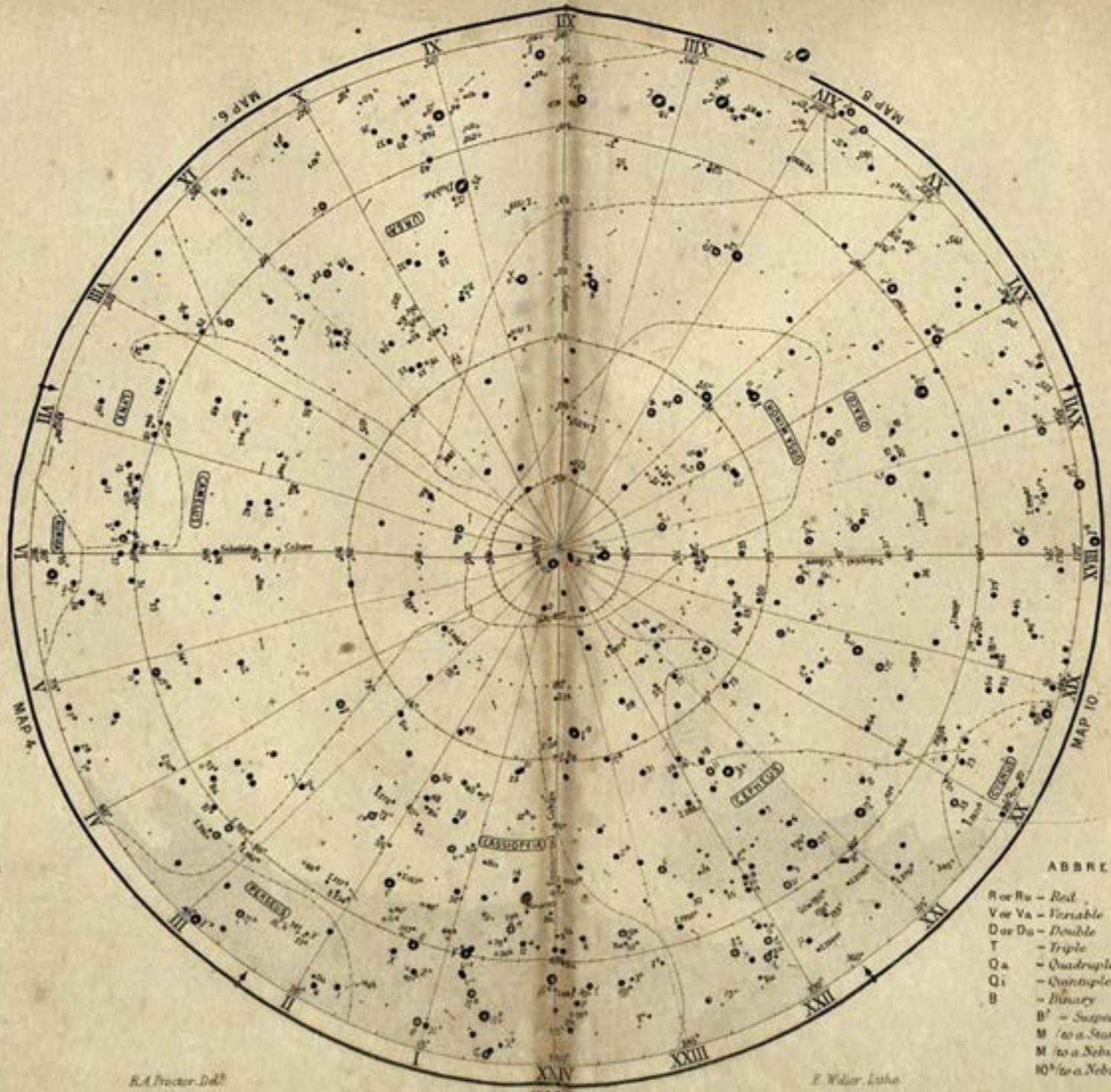
The dates round the map are those on which the corresponding meridians come to the South (in Northern latitudes) at midnight

R.A Proctor Del^t *London Longmans & C^o* *E. Weller Litho.*

MAP I

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and under)
- Nebulæ

ABBREVIATIONS

R or Ru	= Red	Tr	= Trinary
V or Va	= Variable	✠	= 21 Piazzi
D or Du	= Double	H	= Sir W Herschel
T	= Triple	h	= Sir J Herschel
Q	= Quadruple	Σ	= Struve
Q1	= Quintuple	Δ	= Dunlop
B	= Binary	Ru'	= Suspected Red
	B' = Suspected Binary		
	M (to a Star)	=	Multiple
	M (to a Nebula)	=	Messier
	10h (to a Nebula)	=	H.V. 10.

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F. Weber. Litho.

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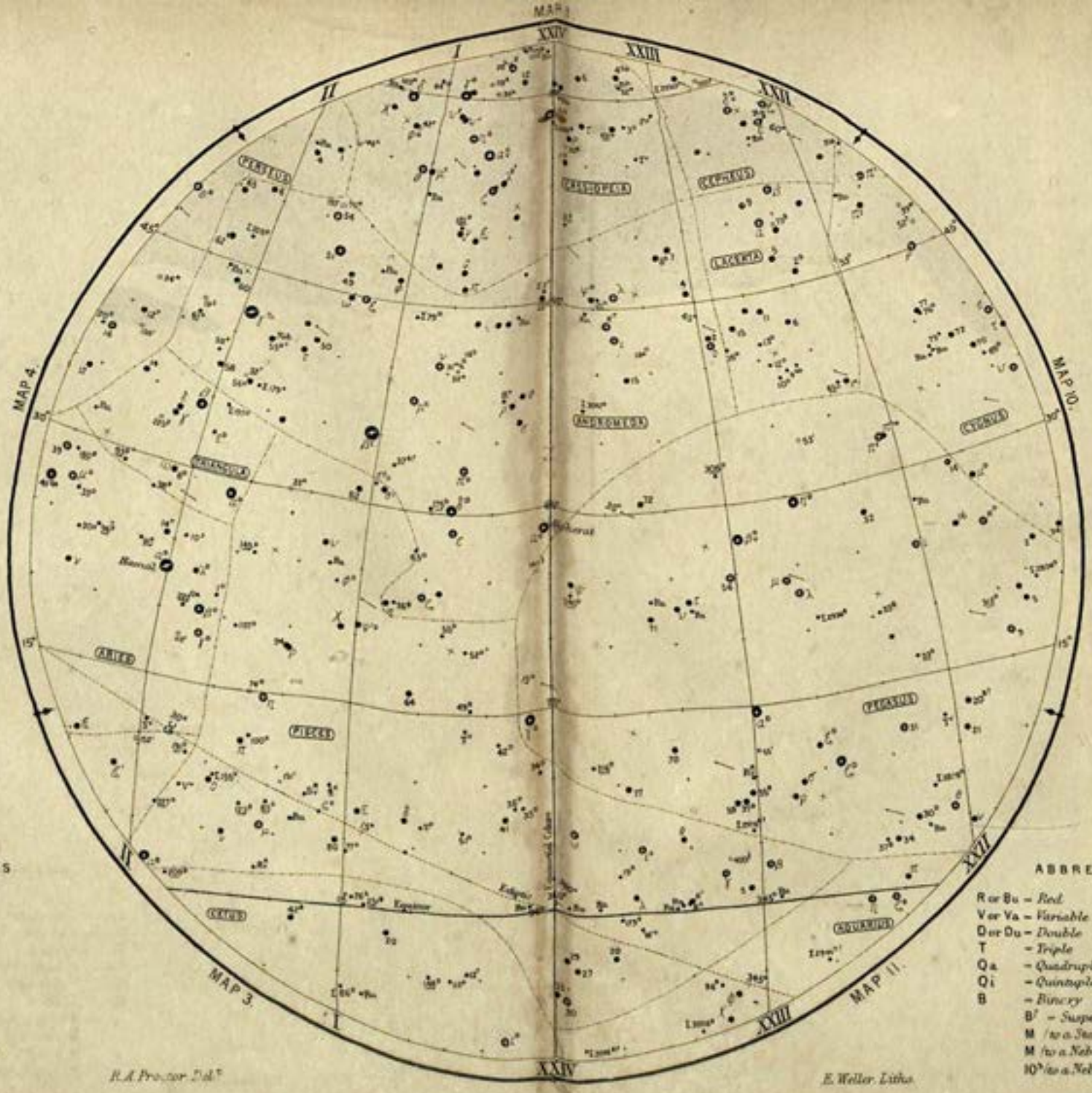
MAP 2

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and smaller)
- Nebula

ABBREVIATIONS

R or Bu	= Red.	Tr	= Trinary
V or Va	= Variable	21	= 21 Piazzi
D or Du	= Double	H	= Sir W. Herschel
T	= Triple	h	= Sir J. Herschel
Qa	= Quadruple	Σ	= Struve
Qi	= Quintuple	Δ	= Dunlop
B	= Binary	Ra'	= Suspected Red.
B'	= Suspected Binary		
M	(to a Star) = Multiple		
M	(to a Nebula) = Messier		
10h	(to a Nebula) = H.V. 10.		

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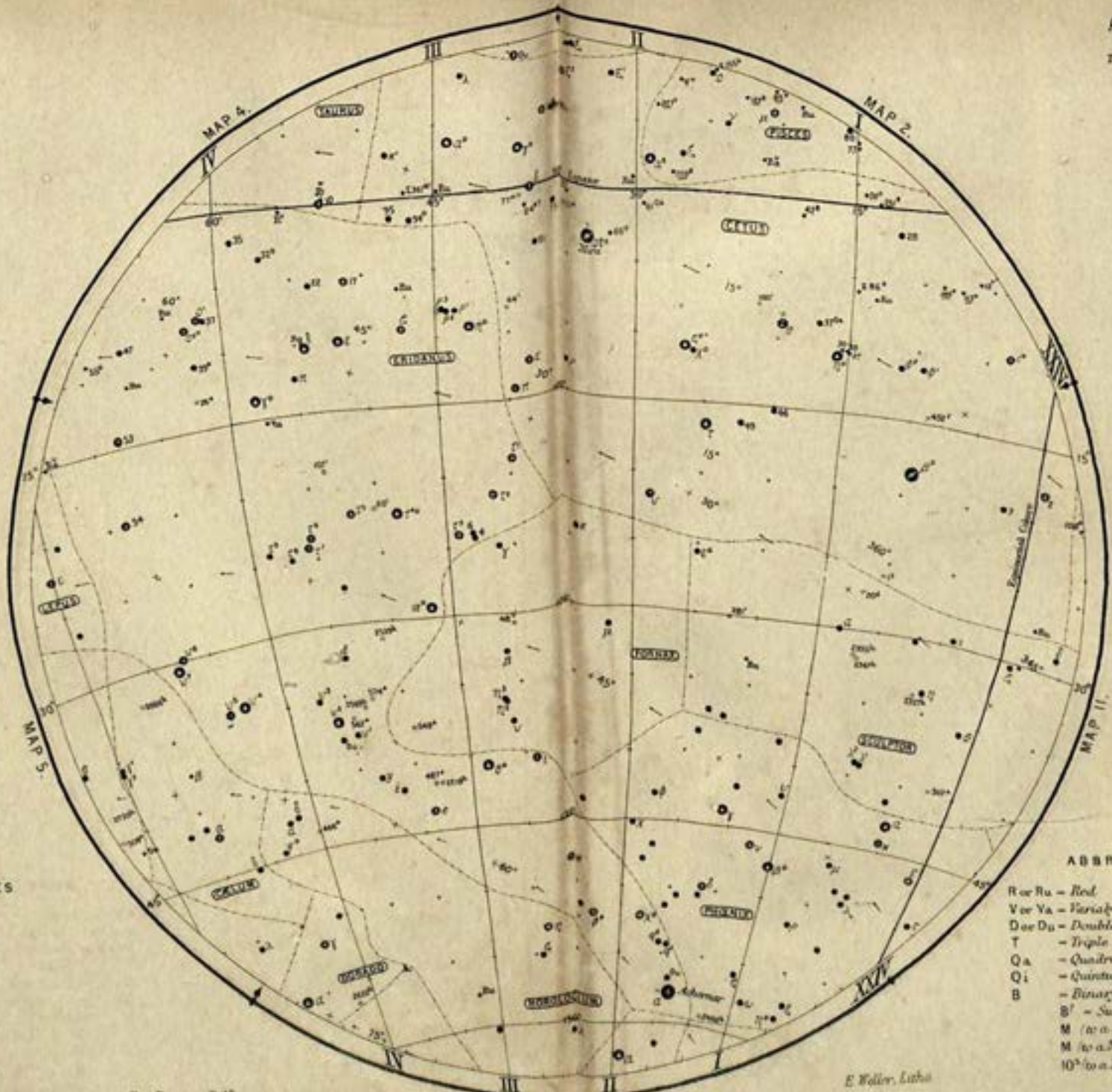
MAP 3

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and under)
- Nebula

ABBREVIATIONS

R or Ru	– Red	Tr	– Trinary
V or Va	– Variable	♀	– 21 Piazzi
D or Du	– Double	H	– Sir W Herschel
T	– Triple	h	– Sir J Herschel
Q	– Quadruple	Σ	– Struve
Q	– Quintuple	Δ	– Dunlop
B	– Binary	Ru'	– Suspected Red
B'	– Suspected Binary		
M (to a Star)	– Multiple		
M (to a Nebula)	– Messier		
10h (to a Nebula)	– H.V. 10		

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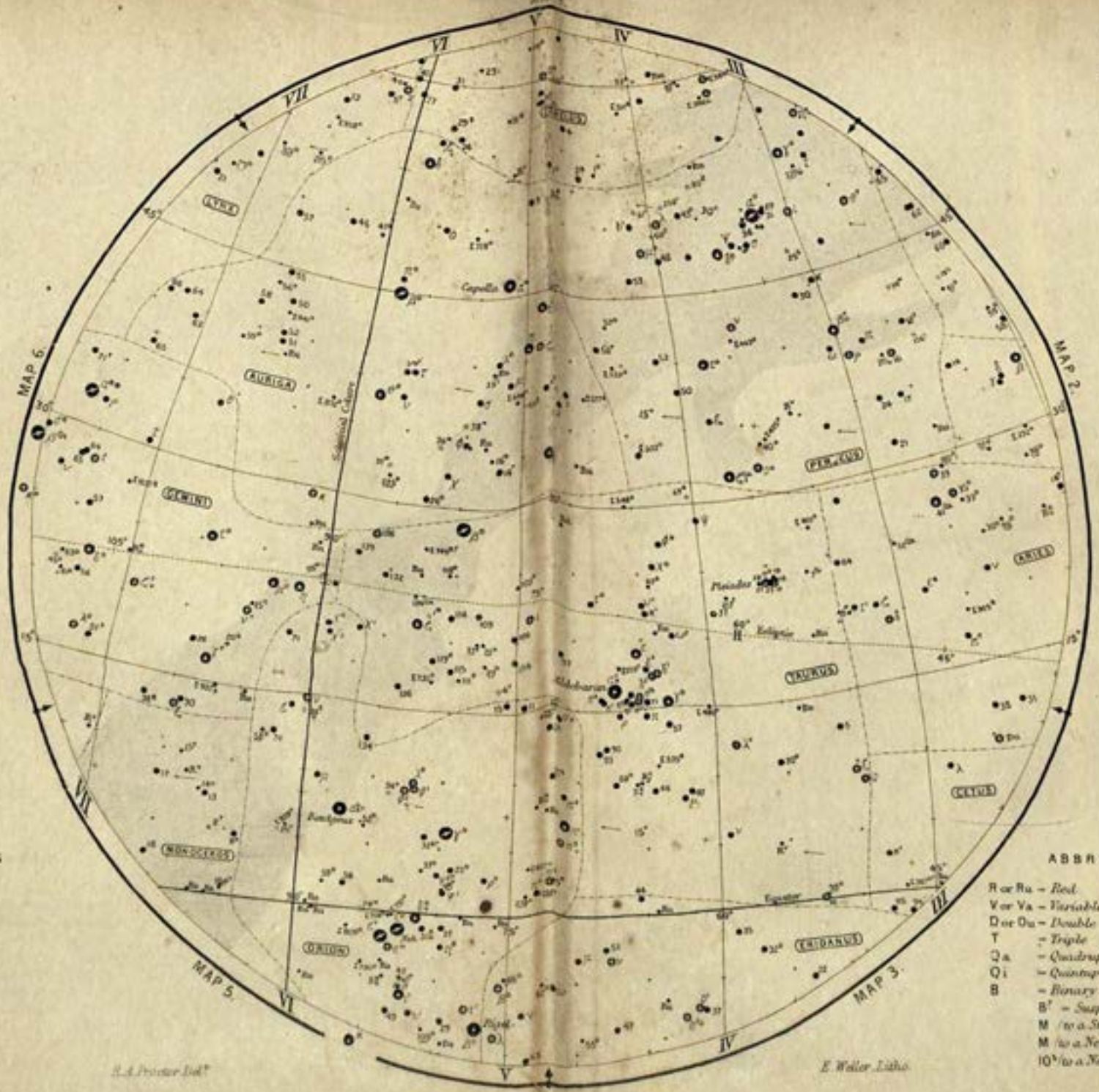
MAP 4

ANNO 1880

The Arrows indicate the Precessional motion for 200 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and smaller)
- Nebula

ABBREVIATIONS

R or Ru	= Red	Te	= Trinary
V or Va	= Variable	♆	= 21 Planet
D or Du	= Double	H	= Sir W. Herschel
T	= Triple	h	= Sir J. Herschel
Qa	= Quadruple	Σ	= Struve
Qi	= Quintuple	Δ	= Dunlop
B	= Binary	Ru'	= Suspected Red
B'	= Suspected Binary		
M (to a Star)	= Multiple		
M (to a Nebula)	= Messier		
10h (to a Nebula)	= H.V. 10		

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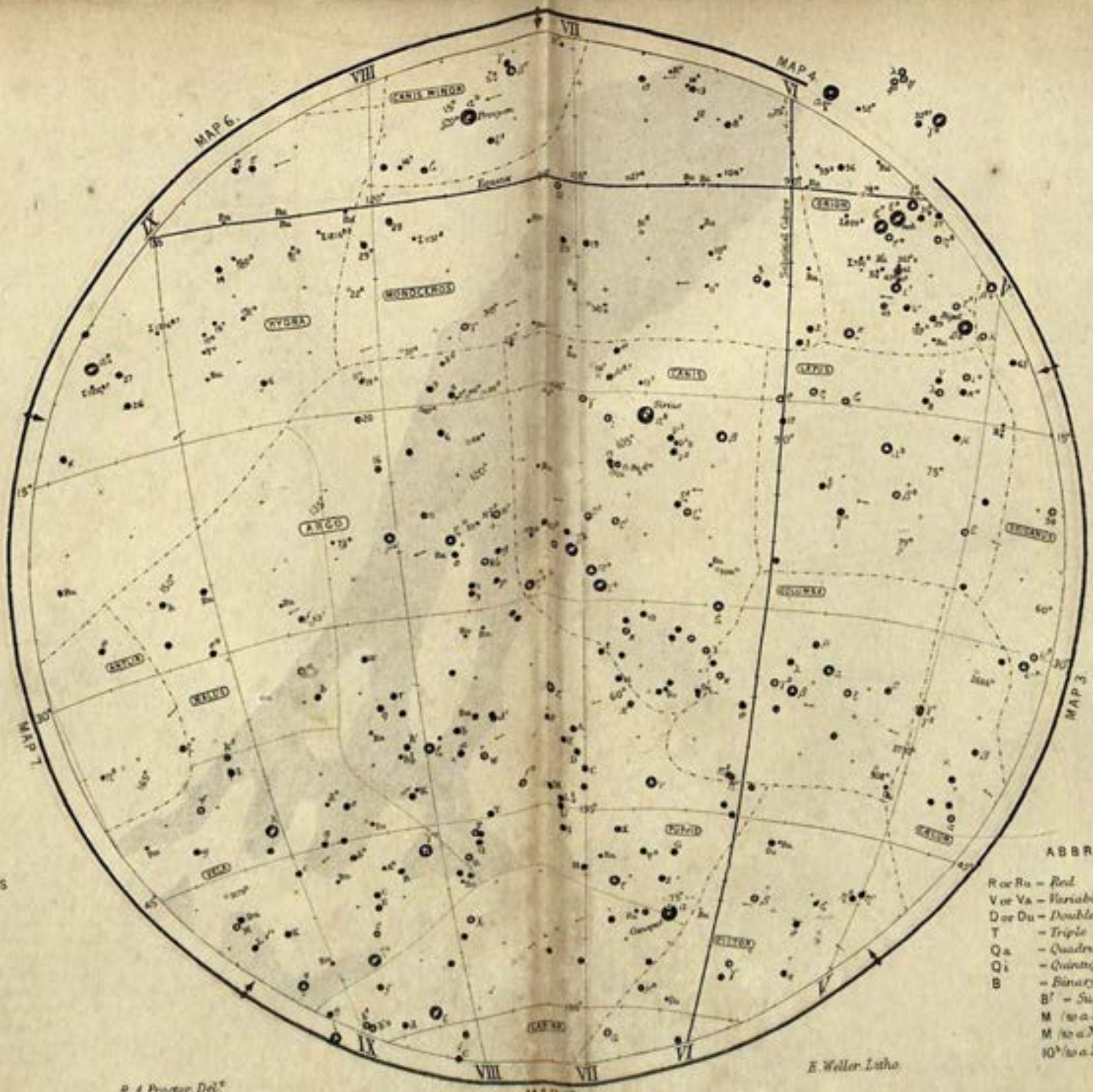
MAP 5

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and under)
- Nebula

ABBREVIATIONS

R or Ru	= Red	Tr	= Trinary
V or Va	= Variable	Σ	= Σ Piazzi
D or Du	= Double	H	= Sir W. Herschel
T	= Triple	h	= Sir J. Herschel
Qa	= Quadruple	I	= Struve
Qi	= Quintuple	Δ	= Dunlop
B	= Binary	Ru'	= Suspected Red
B'	= Suspected Binary		
M	(to a Star) = Multiple		
M	(to a Nebula) = Messier		
10h	(to a Nebula) = H.V. 10		

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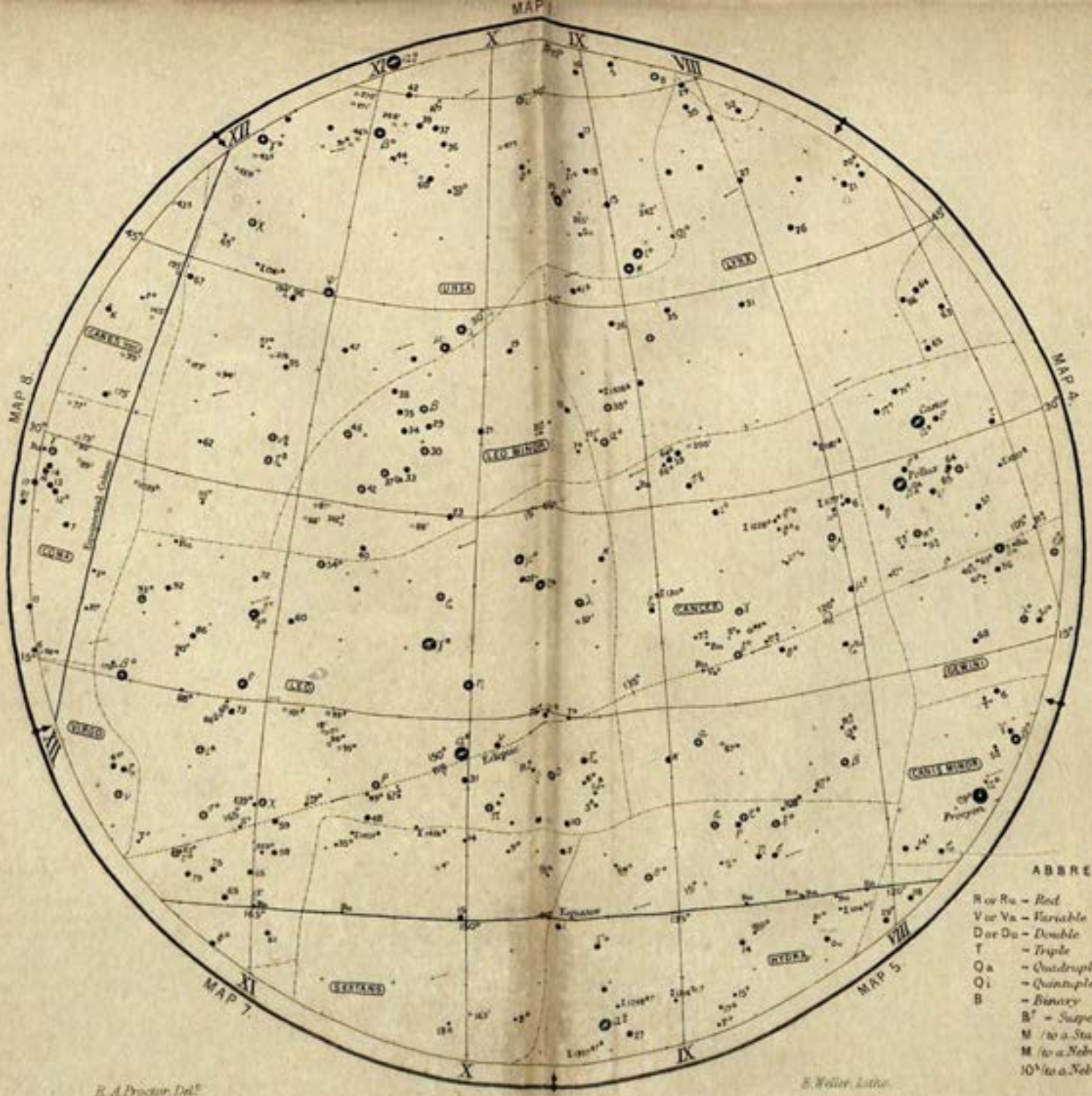
MAP 6

ANNO 1880

The Arrow ; indicate the Precessional motion for 200 Years



STAR MAGNITUDES

- ● = *First*
- ◎ = *Second*
- ○ = *Third*
- ○ = *Fourth*
- • = *Fifth*
- • = *Sixth (and under)*
- · = *Nebulæ &c.*

ABBREVIATIONS

R or Ru	= *Red*	Tr	= *Trinary*
V or Va	= *Variable*	Σ	= *Σ Piazzi*
D or Du	= *Double*	H	= *Sir W. Herschel*
T	= *Triple*	h	= *Sir J. Herschel*
Q	= *Quadruple*	Σ	= *Struve*
Q	= *Quintuple*	Δ	= *Dunlop*
B	= *Binary*	Ru'	= *Suspected Red*
	B' = *Suspected Binary*		
	M (*to a Star*) = *Multiple*		
	M (*to a Nebula*) = *Messier*		
	10h (*to a Nebula*) = H.V. 10		

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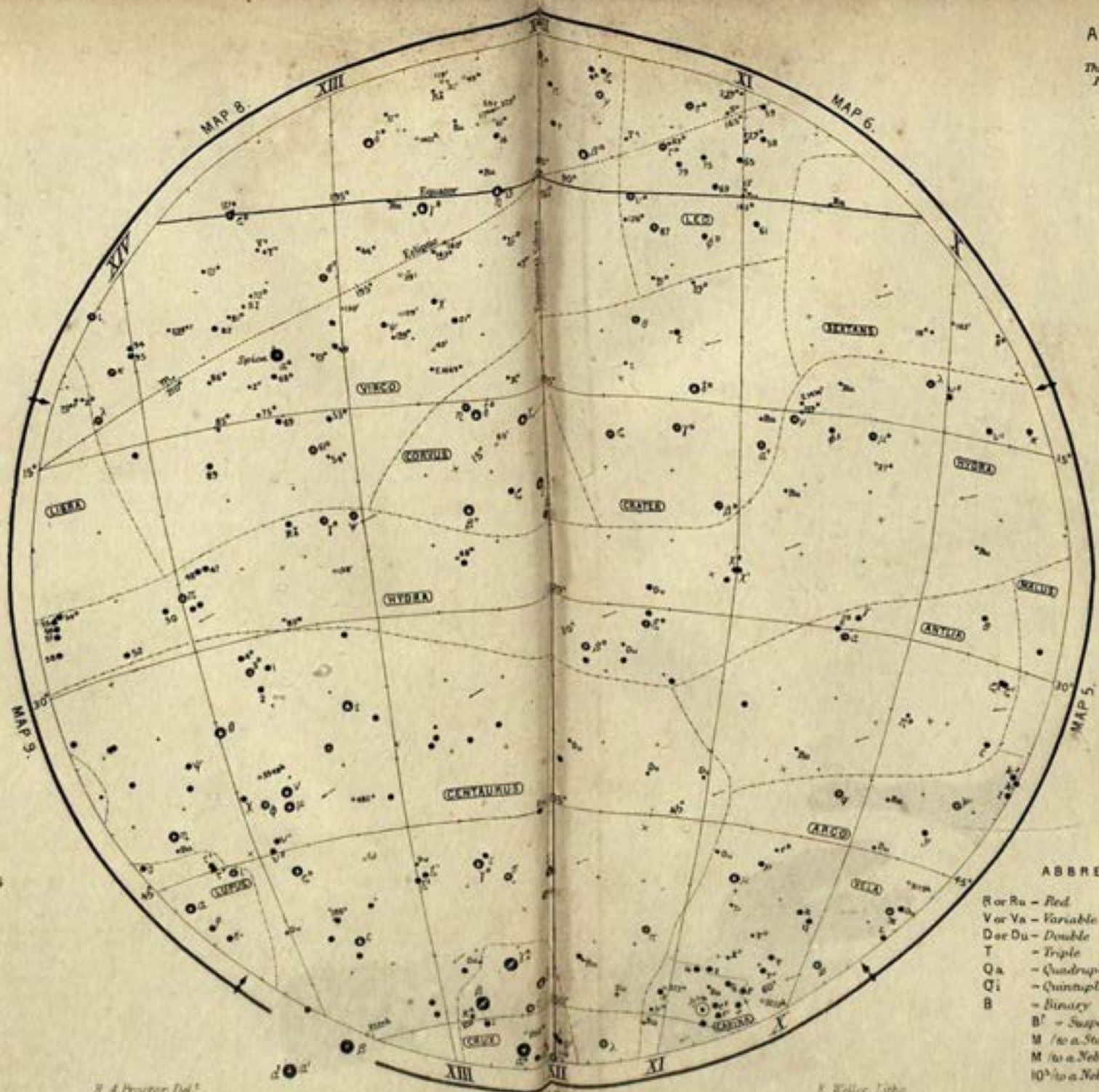
MAP 7

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- ● = First
- ◑ = Second
- ● = Third
- ◎ = Fourth
- • = Fifth
- · = Sixth (and smaller)
- ⊛ = Nebula

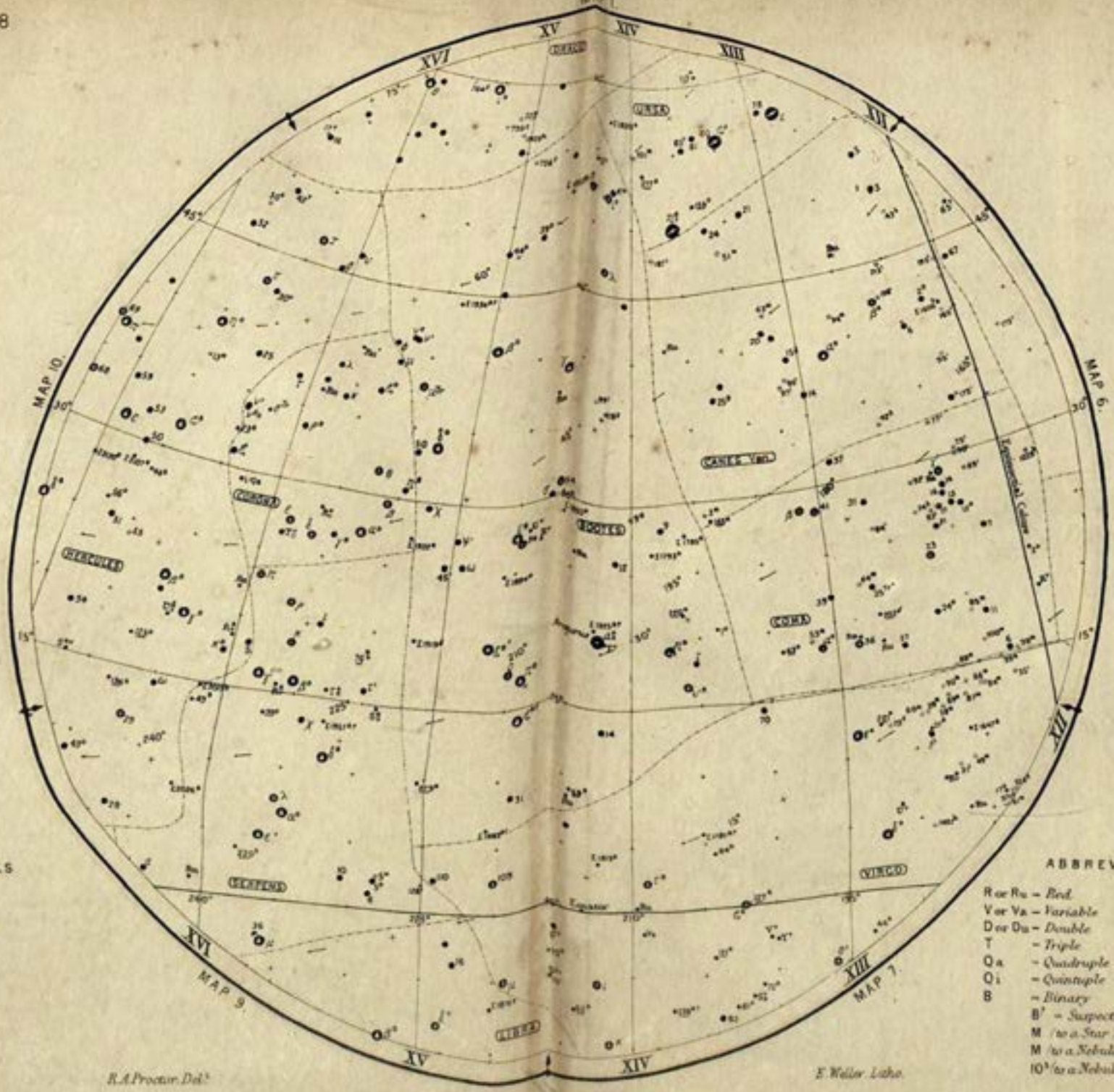
ABBREVIATIONS

R or Ru	= Red	Te	= Trinary
V or Va	= Variable	21	= 21 Piazzi
D or Du	= Double	H	= Sir W. Herschel
T	= Triple	h	= Sir J. Herschel
Q a	= Quadruple	Σ	= Struve
Q i	= Quintuple	Δ	= Dunlop
B	= Binary	Ru?	= Suspected Red
B?	= Suspected Binary		
M (to a Star)	= Multiple		
M (to a Nebula)	= Messier		
10h (to a Nebula)	= H. V. 10		

MAP 8

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and under)
- Nebula

ABBREVIATIONS

R or Ru	= Red.	Tr	= Trinary
V or Va	= Variable	Σ	= 21 Piazzi
D or Du	= Double	H	= Sir W. Herschel
T	= Triple	h	= Sir J. Herschel
Q	= Quadruple	Σ	= Struve
Q	= Quintuple	Δ	= Dunlop
B	= Binary	Ru'	= Suspected Red.
B'	= Suspected Binary		
M	(to a Star) = Multiple		
M	(to a Nebula = Messier		
10'	(to a Nebula) = H.V. 10.		

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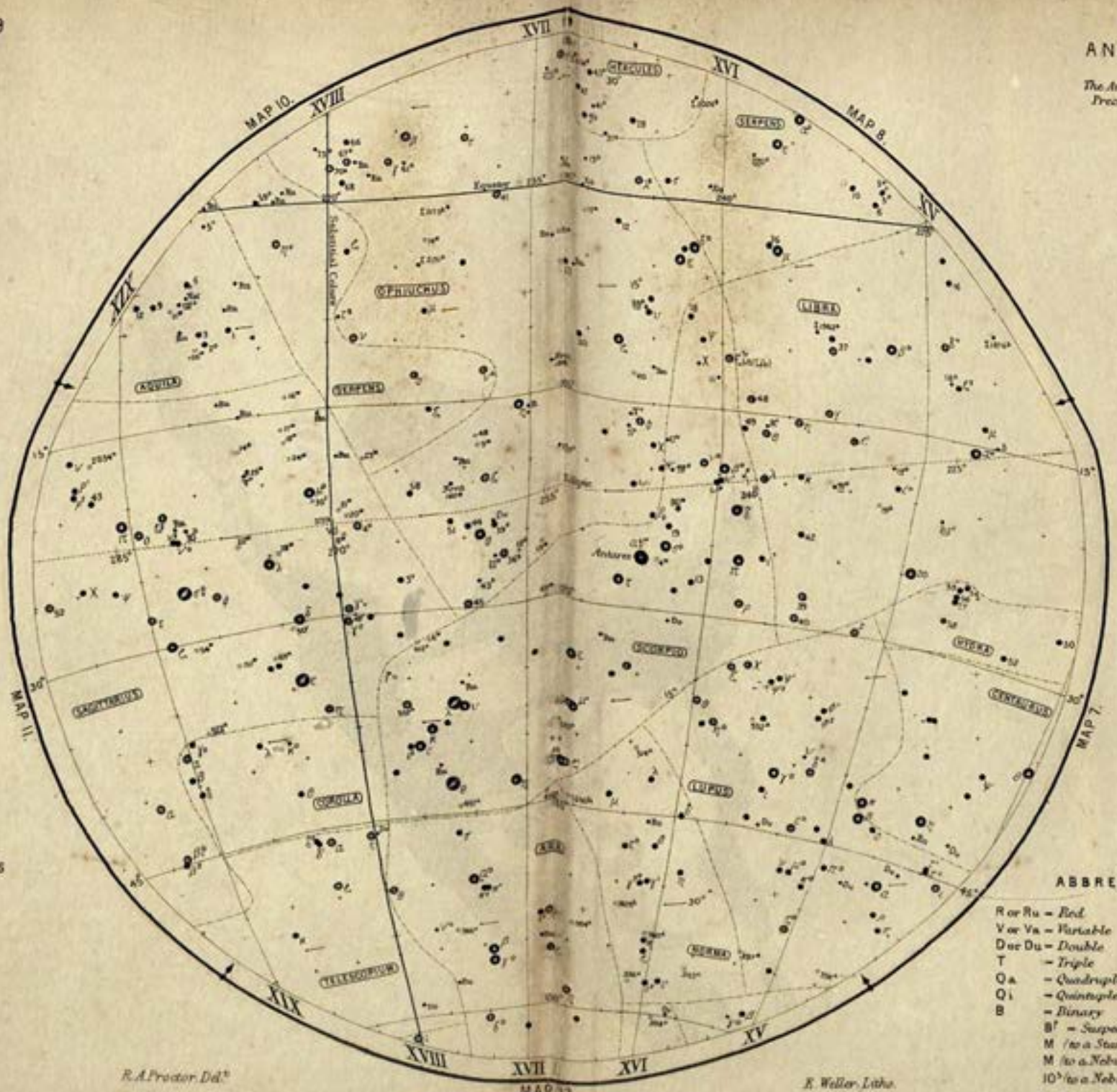
MAP 9

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and under)
- Nebula

ABBREVIATIONS

R or Ru	= Red	Tr	= Trinary
V or Va	= Variable	D	= 21 Piaz.
Dor Du	= Double	H	= Sir W. Herschel
T	= Triple	h	= Sir J. Herschel
Q or Qa	= Quadruple	Σ	= Struve
Q or Qi	= Quintuple	Δ	= Dunlop
B	= Binary	Ru?	= Suspected Red
B?	= Suspected Binary		
M	(to a Star) = Multiple		
M	(to a Nebula) = Messier		
10h	(to a Nebula) = H.V. 10.		

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MAP 10

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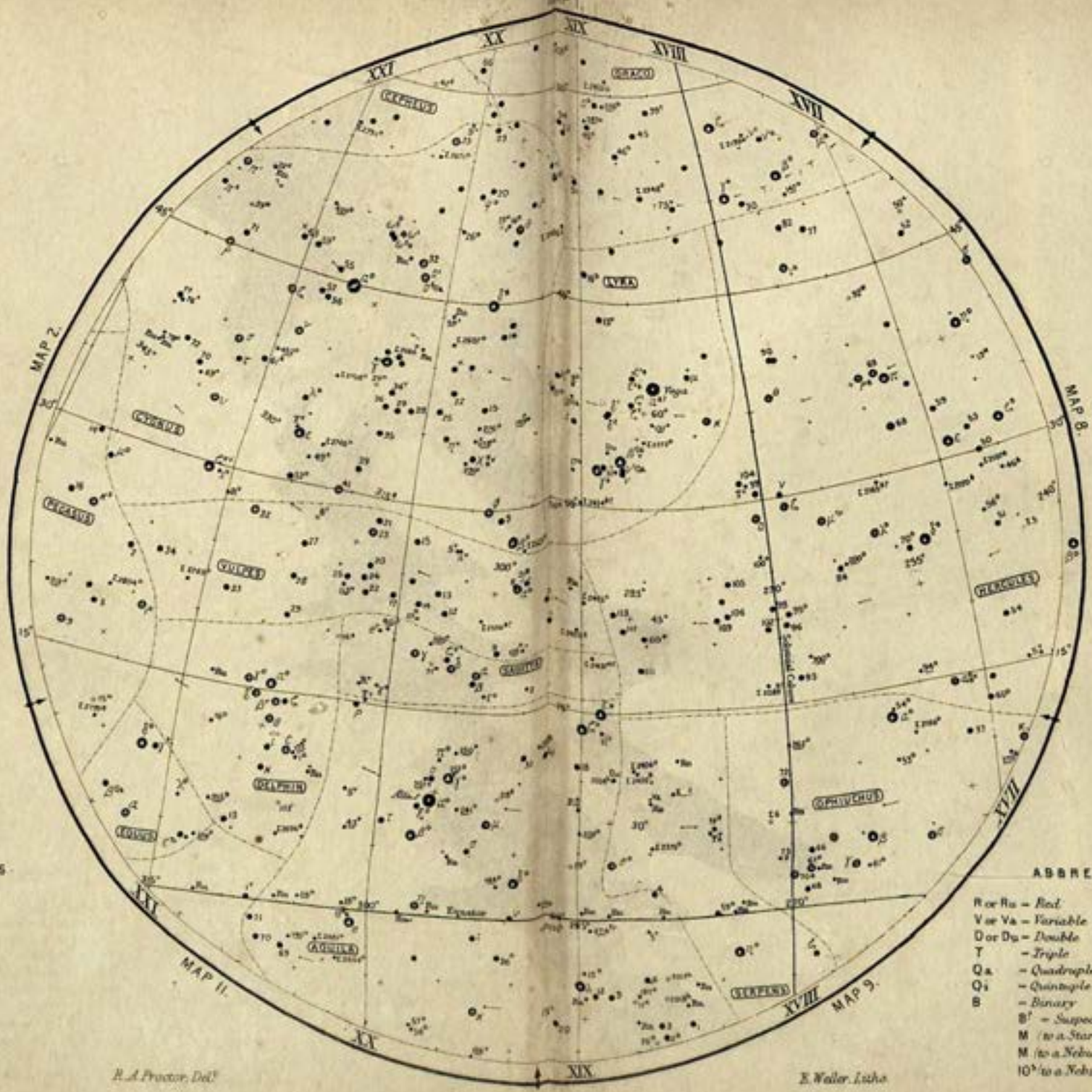
The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- ● – First
- ◉ – Second
- ● – Third
- ◦ – Fourth
- • – Fifth
- · – Sixth (and smaller)
- ⊛ – Nebula

ABBREVIATIONS

R or Ru =	Red	Tr =	Trinary
V or Va =	Variable	21 =	21 Piazzi
D or Du =	Double	H =	Sir W. Herschel
T =	Triple	h =	Sir J. Herschel
Q or Qa. =	Quadruple	Σ =	Struve
Q or Qi =	Quintuple	Δ =	Dunlop
B =	Binary	Ru? =	Suspected Red.
B? =	Suspected Binary		
M (to a Star) =	Multiple		
M (to a Nebula) =	Messier		
10h (to a Nebula) =	H V. 10		

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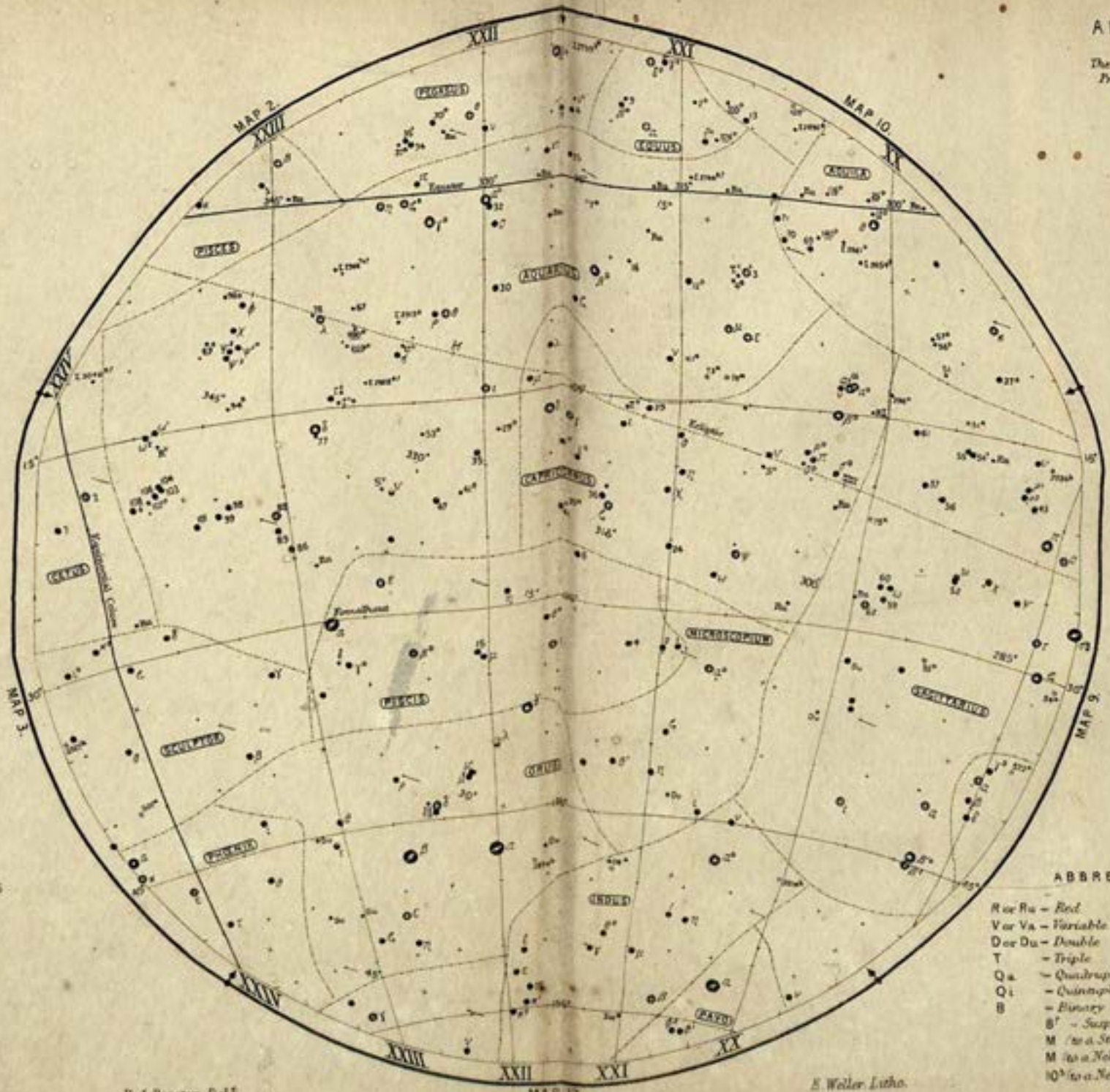
MAP II

ANNO 1880

The Arrows indicate the Precessional motion after 200 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and under)
- Nebula

ABBREVIATIONS

R or Ru	= Red	Tr	= Trinary
V or Va	= Variable	21	= 21 Planes
D or Du	= Double	H	= Sir W Herschel
T	= Triple	h	= Sir J Herschel
Qa	= Quadruple	Σ	= Struve
Q	= Quintuple	Δ	= Dunlop
B	= Binary	Ru'	= Suspected Red

B' = Suspected Binary
M (as a Star) = Multiple
M (as a Nebula) = Messier
10h (as a Nebula) = H.V. 10

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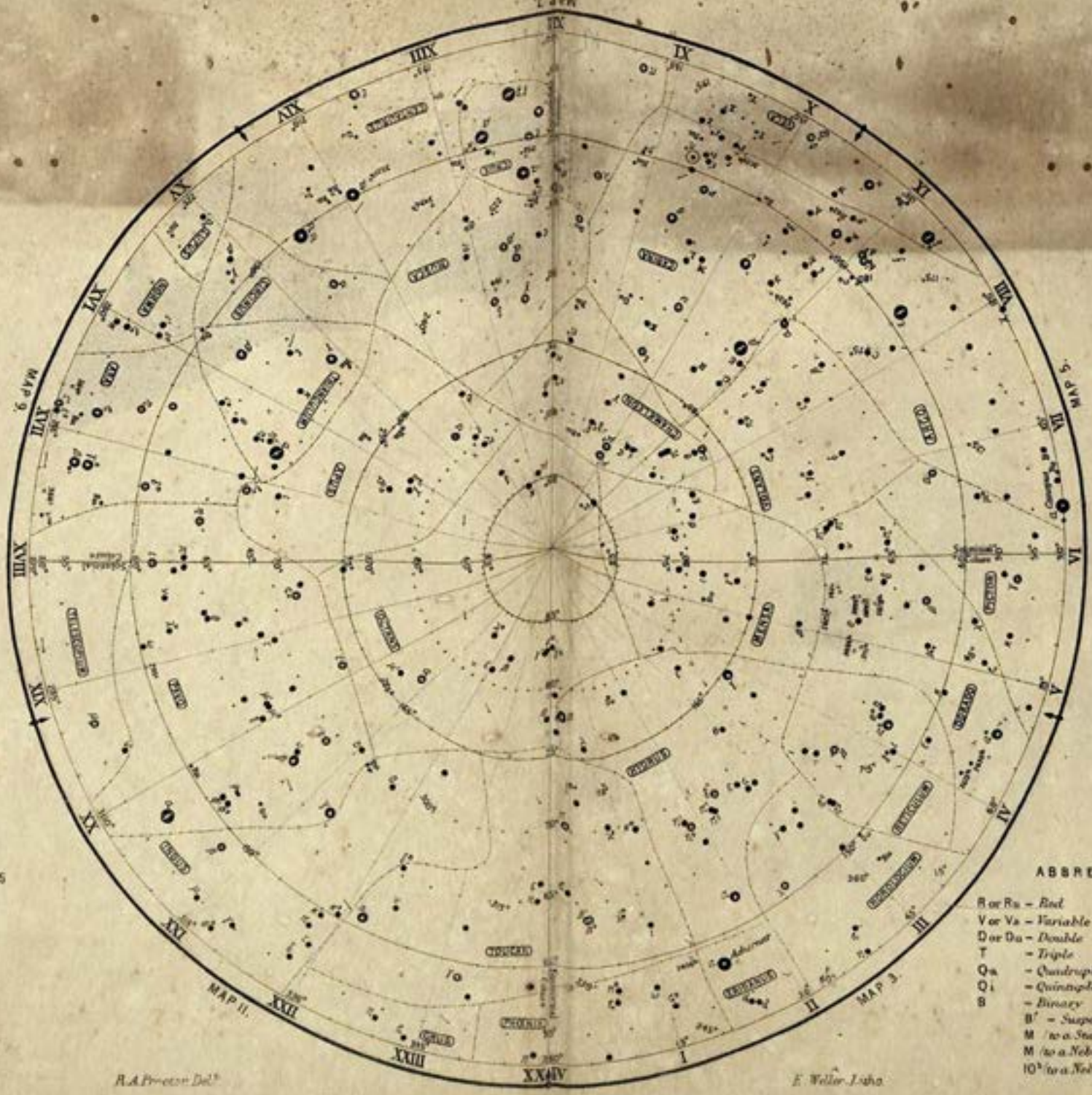
MAP 12

ANNO 1880

The Arrows indicate the Precessional motion for 100 Years



STAR MAGNITUDES

- First
- Second
- Third
- Fourth
- Fifth
- Sixth (and under)
- Nebulæ

ABBREVIATIONS

R or Rs	– Red	Tr	– Trinary ⊙
V or Vs	– Variable	♊	– 21 Piazzi
D or Du	– Double	H	– Sir W. Herschel
T	– Triple	h	– Sir J. Herschel
Qa	– Quadruple	Σ	– Struve
Qi	– Quintuple	Δ	– Dunlop
S	– Binary	Rs'	– Suspected Red
	S' – Suspected Binary		
	M (to a Star)		– Multiple
	M (to a Nebula)		– Messier
	10^h (to a Nebula)		– H. V. 10.

R.A. Proctor Del.

E. Weller Litho

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